ENGINEERING NEWS

AND

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THE BUILDING STONES OF CHICAGO.*

Chicago is very rich in building-stone—in quantity, quality and variety. Lake Michigan and Lake Superior afford cheap transportation for the Vert Island sandstone of Canada, which is being used in the Royal Insurance Company's building; for the Marquette sandstone and for the marble of Delta County, Mich., etc., while the chain of lakes connecting with the canals opens to us the quarries of the sandstone of Northern Ohio, and the red sandstones of New York and Connecticut, and also all the granite quarries of New England, and not only these, but also the quarries of Scotland, from which we receive several varieties of granite and one excellent red sandstone, while our great system of railroads brings to Chicago every known building-stone in the country that is worth the transportation. We have the green stone of Philadelphia, the Beuna Vista stone of the Ohio river, and the rich cream-colored limestone from Minnesota, and many others, as well as our local quarries, so that it may well be called an "embarrassment of riches."

A building-stone is one which by its chemical composition and physical structure is capable of resisting atmospheric influences and sustaining considerable pressure, and when used for architectural purposes the color and texture are matters of material importance, for they form a part of the design. It is easy to see the importance of the numerous contrasts that the great variety of the stone before us offers to the architect.

In large cities the consumption of coal, particularly bituminous coal, the numerous manufactories, the decomposition of organic matter, etc., generate gases that contain deleterious substances that are absorbed by the rain, fog, and dew, and thereby deposited on the surface of the stone and taken into the pores. The conditions are then favorable for injurious action of the chemicals.

These destroying substances consist of sulphuric, muriatic, nitric and carbonic acids. They will soon disfigure the surface and edges of porous stone composed largely of the carbonates of lime and magnesia, and will ultimately destroy the stone, though the time required to be so serious as to effect the stability of the work is usually beyond the lifetime of the building. Still there are many examples where the delicate tracery of gothic windows has been entirely eaten away.

Stone containing much iron is acted upon by the oxigen of the air alone, and there is sufficient carbonic acid even in the pure air of the country to attack some limestone. Sulphuric acid will sometimes form crystaline sulphates in the pores of the stone. These sulphates in crystalizing increase in volume, which scales off the surface of the stone, exposing a new surface to be scaled off in a similar manner, and this action will continue so long as any stone remains. We can readily understand that some stone will weather very differently in different localities, also that dry weather is favorable to the durability of stone. The fine preservation of the obelisks and other monuments in Egypt for 3,000 and 4,000 years is largely due to the dry climate.

The injurious action of frost on some stone is due to the expansion of water at the moment of freezing while in the pores of the stone. Frost has no action whatsoever on dry stone. We can understand from this why it is so necessary that the quarry water or sap, as it is called, should dry out, or the stone season, to use a common expression, before it is exposed to the frost. This quarry water pervades the entire mass of the stone, and upon freezing cracks the largest blocks, while, after the stone is once seasoned, the rains penetrate but a short distance, and the injury from frost is confined to the surface. Drying winds are favorable to the durability of stone, while heavy, beating rains penetrate deeper than otherwise, and increase the damage. In localities where a strong wind blows the sand against the surface of stone the surface is ground and gradually worn after the well-known manner of the sand-blast.

Stone on a side of a building most exposed to the wind and rain is more rapidly injured than those less exposed. Stone near the moist ground and those in shadow where they dry slowly are unfavorably situated.

The physical structure of building stone is no less important than the chemical. For example: Marble and chalk, free from coloring matter, are the same, chemically, both being nearly pure carbonate of lime, while, physically, they are quite distinct. Marble is crystalline and capable of resisting atmospheric actions, while chalk is amorphous, and soon crumbles to dust. There are, however, some hard stones that don't weather well.

Very porous stone should not be used for the exterior of buildings in our climate, as they absorb large quantities of water, and, in consequence, are much exposed to the action of acids and of frost. Besides this, the pores fill with dirt and form a garden where minute lichens flourish, whose roots penetrate the pores and hold moisture that contributes to the surface-injury and disfigures the stone, though they may prevent the action of an acid atmosphere. Other things being equal, the most porous stone is the least likely to weather well. It is important that stone should be homogeneous. The soft patches which are numerous in some stone soon wear away leaving holes, which not only disfigure the surface but expose the harder parts to increased wear.

Facility of working is important from an economical point, and often governs the selection of the stone.

For carving, a stone is required of fine homogeneous texture, free from any naturally cleavage and easily cut, and at the same time must weather well, if for out-door use, or the fine parts of the work will crumble away. While a hard stone, with natural cleavage, or naturally in thin layers like our Lemont stone, makes excellent sidewalk stones and vault covers, while the fragments are easily worked as rubble. For paving stone toughness as well as hardness is essential, for they should neither wear into dust nor splinter under the wheels of heavily loaded teams. Granite is particularly adapted for the lower course or water table of buildings, for this course is particularly exposed to wear and to wetting. Not only does it receive more knocks and rubs than any other part of the building, except the entrance, but rain striking the sidewalk or ground near the building spatters against the water table adding to the wetting. I had occasion to examine a very costly house, where the water table of soft red sand stone, some fourteen inches high, was so badly injured from this cause after only seven or eight years' exposure, as to require replacing.

Stone varies greatly in its ability to resist heat. Some stone turns to lime; of which there were acres of examples after the great Chicago fire. Granite cracks and crumbles; while stone like soap stone, which is used for lining fire-places, and the Iowa marble, which is used for facing fire-places, will stand quite a high temperature for a long period. A stone-cutter, after the Chicago fire, told me that the Iowa marble was the only stone in his yard worth the removing. Nearly all good building stone are seriously injured by fire. When it is a question of resisting conflagrations, brick and terra cotta are the best material—far superior to any stone. I have just received two one-inch cubes of the Vest Island red sand stone, one of which has been subjected to a high temperature and then thrown into water until cooled. It is but slightly injured. Most stone so treated would be shattered into fragments.

The strength of stone, its ability to resist compression and cross strains, is at times of great importance, especially now that we are building of a height to rival the Tower of Babel, and loading them with iron and concrete floors. In ordinary buildings the weight upon the stone is but a small fraction of what it will carry with safety, although the safety load should never exceed $\frac{1}{10}$ of the crushing load. I find a statement that the greatest stress that comes upon any part of the masonry in St. Paul's Cathedral, London, does not exceed fourteen tons, and in St. Peter's, at Rome, fifteen tons per square foot. Good sandstone will carry double the amount. There are some stones in buildings, like piers in lower stories and some arches, where from unequal shrinkage of joints, or from some slight settlements of foundation, extra weights may occur that cannot be calculated. In such cases the safe load should not exceed $\frac{1}{20}$ the crushing weight.

The weight of the stone is of some importance; for example, in retaining walls and in break-waters the weight is an element in the calculation, and the heavier a cubic foot of stone the greater its resistance, while in arches, for example, it counts against the load, and a light, strong stone can advantageously be substituted.

For architectural work the appearance of the stone is of great importance.

1. The stone must weather well or, however handsome it may be at the outset, the work will soon become very untidy and be seriously disfigured.

2. The stone should be free from soft spots, flaws, blotches, from any considerable quantity of iron, and from petroleum. The Buena Vista sand stone, used for the old Board of Trade and Custom House Buildings, contains, in many parts of the quarry, both iron and petroleum. The iron soon develops in large iron-rust spots, and the petroleum in great green spots that will ruin the appearance of any building. You all, doubtless, remember the old Second Presbyterian Church that before the fire stood on the corner of Washington street and Wabash avenue. It was built of prairie stone that is filled with petroleum, or allied substances, that the heat of the sun soon brings to the surface, where it collects the dust and soot and soon presents a very untidy appearance. It is surprising to see such stone used in a private city residence. It is, however, valuable for rustic work in parks or grounds.

Stones of a laminated structure should be built into the work so as to expose the edges and not the face of the laminæ to the weather, for if the face is exposed lamina after lamina soon scale off. The difference in strength is not great. Some experiments in England showed a loss of one-seventh by placing the strata vertical.

The numerous samples before me show that Chicago is very rich in varieties of building stone. They come to us from the North, the South, the East, and the West; from Canada to Tennessee; from the coast of Maine to beyond the Mississippi; and represents every degree of hardness and softness, and every variety of texture and color.

The question, what shall be used? arises with every building erected. The appearance, after a few years exposure, in the building should govern every choice. This can readily be learned after the stone has been used for some time in similar external conditions. But it often happens of late, that new quarries are opened or stone presented in Chicago that heretofore has been used in the country, and the architect must judge of the qualities of the stone for city use by an examination of a few specimens.

The atmospherical conditions of the country are very different from the city. For example, I examined the Bedford stone in a court house in a small town near the quarry built some ten years before. The stone was whiter than in the building near by that was just being completed. I also visited Louisville, and saw the same stone in some dwelling houses in the residence quarter. Here the stone has a soft, light gray color, about the color of unbleached linen. I also examined the same stone in buildings in the center of the business quarter, where it was exposed to much smoke and dust, and here it was a very dark, cold gray, about the color of an old

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* Paper read before the Chicago Academy of Science, November 27, 1883, by W. L. B. Jenny, Architect.

AUTHORITIES.—Notes on Building Construction. South Kensington. Part III.

THURSTON.—The Materials of Engineering. Part I.

DANA.—Mineralogy. Geology.

Q. A. GILLMORE.—Tests.

PROF. CHANDLER.—School of Mines, New York.

MERRELL.—Smithsonian Institute.' Analysis.

PROF. J. V. Z. BLANEY.—Analysis.

shingle roof after a rain. In the first two instances this stone presented a very handsome appearance, while in the last it was black, dingy, and unattractive. The weathering qualities of this stone, as regards durability, were excellent in all three instances.

Speaking generally, in comparing stone of the same class, the least porous, most dense, and strongest will be the most durable in atmospheres which have no special tendency to attack the constituents of the stone.

When we are forced to judge of the qualities of stone for building purposes from specimens only we may acquire a certain amount of information from the following tests:

A recent fracture when examined through a powerful magnifying glass should be bright, clean, and sharp, with the grains well cemented together. A dull, earthy appearance betokens a stone likely to decay.

Its resistance to crushing may be ascertained by crushing one-inch cubes. This test is of more or less importance according to the use to be made of the stone, and in important buildings should certainly be approximately known. It is claimed by some authorities that it gives some idea of the ability to resist frost, but I think this test is only valuable in comparing stones of similar character—sandstone with sandstone, etc.

An important test is to compare the new stone with a well-known similar stone by immersing the two, after thoroughly drying, in water for twenty-four hours, and weighing the stones both before and after immersion. As a rule the best stone absorbs the least weight of water. I find a table published with the South Kensington Notes on Building Construction: Good granite absorbs ½ per cent. of water, indifferent granite absorbs 1 per cent. of water, very bad granite absorbs 3 per cent. of water. Very durable sandstone absorbs 8 per cent. of water, moderately durable sandstone absorbs 10 per cent. of water, very bad sandstone absorbs 20 per cent. of water. Good limestone absorbs 13 to 16 per cent. of water.

There is an examination known as "Brard's test." Small pieces are immersed in a concentrated boiling solution of sulphate of soda, and then hung up for a few days in the air. The salt crystalizes in the pores of the stone and sometimes forces off bits and even quite large fragments. Weigh the stone before and after the test, the difference gives the exact amount detached. The greater this is the worse the quality of the stone.

The acid test consists in immersing the stone for several days in a solution of water to which 1 per cent. of sulphuric acid and 1 per cent. of H. Cl. is added. The effect on the stone, as compared with the effect upon a well-known stone of similar character, will give some idea of the power to resist a city atmosphere.

There is a test known as the C. H. Smith test; it is for the purpose of learning if the stone contains earthy or mineral matter easy of solution. Thoroughly wash and even soak the stone to be tested, and then chip off thin flakes of the size of a dime or a quarter of a dollar, and put them to soak in a glass, covering them with distilled water, and covering the glass to keep out any dust; allow the glass to stand quietly at least a half hour, and then agitate by giving the glass a circular motion; decant of, and examine the water. If it is clear it shows that the stone is highly crystaline and well cemented, but if the specimen contains uncrystalized substances or earthy powder the water will be milky or turbid.

If the parties making the examination of a stone can visit the quarry, they should look for outcropping and for detached stones that have been long exposed to the weather. When these can be found they will give valuable information in regard to weathering qualities, which are all in all the most important. One must be sure these detached pieces come from the part of the quarry under examination, for the different strata are often very different in quality.

Stones for building purposes are classified as granites and other igneous rocks, slates and schists, sand-stone, lime-stone.

Granite is a primary rock; compact, crystalline and unstratified; it is composed of feldspar, quartz, and mica crystallized promiscuously together; the proportions varying greatly; Dana gives a kind of average composition: feldspar 40 per cent., quartz 30 to 40. There are many varieties of granite. Mr. Bodwell, of the Hollowell & Bodwell Granite Co., tells me that he has a collection of over sixty. The varieties are caused by the character and proportion of the ingredients, and the manner in which they are assembled.

The *quartz* is pure silica, a very hard glassy substance in crystals or amorphous, grey white or colorless.

The *feldspar* in good granite is crystalline, lustrous, and not earthy in appearance. Its grains are of different shape and size, and the color runs through a large variety of shades, from white to grey yellow to brown, pink to red, etc.

The *mica* is silicate of alumina with iron manganese and magnesia in semi-transparent glistening scales, which can easily be flaked off with a knife. The color may be brown, dark grey or black.

The durability of granite depends upon the quantity of quartz, the nature of the feldspar and the disposition and quantity of the mica. If there is much quartz it will work hard, but will weather well if the feldspar is good.

Feldspar is silicate of alumina with silicates of lime, soda and potash, in groups of three or all together. The most common form of feldspar in the best granites is oligoclase or soda feldspar. The potash feldspar or orthoclase is the most liable to decay. If the mica or the feldspar contain an excess of lime, soda or iron, the granite is liable to decay.

Iron, either as the oxide, or as the white radiated pyrites (called marcasite,) affects the durability of granite as well as all other stone, if in considerable quantity. It can be detected by soaking a sample in water to which one per cent. of nitric acid is added, and then exposed to a dry atmosphere. It can often be seen with a good glass.

The bright yellow iron pyrites crystalized in a cubical form, appear to do little harm. These crystals have been found in a bright, unaltered condition in Glasgow in the slate of a roof one hundred years old. Chemically, these two forms of pyrites are the same, although physically so distinct. The white radiated pyrites decay quickly. In using granite in several varieties in the same building the best effect is produced by placing those of finest grain near the eye.

I have here samples of some of the numerous granites brought to Chicago:

The Hallowell White granite is quarried at Hallowell, Me., about two miles below Augusta, on the Kennebec river. This quarry is fully developed and is capable of furnishing 20,000 tons of large building stone in a year. This granite is composed of quartz and feldspar with a little mica. It is fine grained and has been tested with a crushing weight of 25,000 pounds per square inch. It has a rift parellel with bed. This stone is used for the new State House at Albany, N. Y., and on the South front of the new Board of Trade in this city. This granite is used for buildings and monuments.

Fox Island or Harbor granite, used in the three principal fronts of the new Board of Trade in this city. This stone is from extensive quarries on Fox Island, S. E. coast of Maine. It lies in very thick sheets. It is coarse in fleck and of a medium gray color. It has a rift lengthwise of vein and perpendicular to the bed. Used exclusively for building. There is also on Fox Island a quarry of fine dark mixed gray, and one of black granite.

The *Jonesboro Granite* is quarried at Jonesboro, Me. it is of redish color, coarse in fleck. Like all the red granite, the stone is difficult to quarry, it having been deposited in mass and in large boulders instead of layers like, for example the White Hollowell. The first story of the new Pullman office building, is entirely constructed of this granite.

At St. George, New Brunswick, is found a granite of a deep red color, it is said to be the deepest red of any known quarry. This stone is also quarried with difficulty and has neither rift nor grain. The entrance to the First National Bank building in this city is of this stone.

At Sprucehead near Thomaston, Me., is found a granite with coarse black, white and green grains, it is easy to quarry and to work, was used in the post office at Atlanta, Ga. I have also samples of Rhode Island granite Quincy granite, red granites, etc., etc.

Gneiss. All the stone usually called granite are not true granite—some are *Gneiss*, which has the same composition as granite but with traces of lamination, caused by the mica and other ingredients, being more or less in layers. Gneiss splits most easily in the direction of the mica layers. Others are Syenite and Syenitic granite. True Syenite consists of quartz, felspar, and hornblend, it differs from true granite by the substitution of hornblend for mica.

Syenitic Granite is composed of crystals of quartz, feldspar, mica and hornblend. That is to say, the composition of true granite with the addition of hornblend. This is the stone found in Syene in Upper Egypt, whence the name syenite and Syenitic granite for stone resembling granite and containing hornblend.

These syenites are generally of darker color than ordinary granite, caused by the grains of hornblend which is a silicate of lime and magnesia, and in the dark green and black varieties contains much iron. It is very tough and horn like, whence the name. If the feldspar is of good quality, hornblend granite is exceedingly durable, and will take a fine polish.

Porphyritic Granite contains large, distinct, independent crystals of feldspar, scattered at random through the mass.

Trap Rocks consist of feldspar and hornblend. They are very hard and tough and make good road metal and paving stones, but are not much used for building purposes.

Green Stone is allied to trap and although called green stone, some varieties are nearly black. The grains are not as coarse as in granite. The color is due to chromium. Green stone is found on the Hudson just above New York and in the Orange Mountains of New Jersey. These stones are durable but cannot be obtained in large blocks and are therefore only used for irregular Ashlar work. The green stone in this market is called Philadelphia or Pennsylvania. It is quarried in the eastern part of that State.

Next in order is *Slate*, an argillaceous rock compact and fine grained. Originally a sedimentary rock, but will no longer divide along the planes of bedding but split readily along what is called the "planes of slaty cleavage," to which is due our roofing slate—not a building stone in one sense, but it is the best roof covering yet introduced, although one of the oldest. A good slate should be both hard and tough, it should give a sharp metalic ring when struck. It should not splinter under the slater's *zax*, should be easily "holed" without danger of fracture and should not be tender or friable at the edges.

One excellent quality in slate and the one that is my excuse for mentioning slate among the building stones is that it will not absorb moisture to any considerable extent which makes it very valuable as a damp course, for which it is often used in Europe, more than in this country. If the top of the basement or foundation walls soon after they are clear of the ground, are covered across their entire thickness with a layer of good thick slate laid in clear Portland cement mortar, it will effectually prevent any moisture from ascending the walls. This is really more important than is usually supposed, not only for outer walls but also for basement partitions, in which in many of our city houses I have traced the moisture up the brick work, five or six feet by the discoloration and it no doubt ascended much higher.

We will now pass to sedimentary Rocks.

Sandstone was formed in all the later geological periods. It is a stratified rock, consisting of grains of sand derived from the disintegration of silicious rock cemented together by a natural cement composed usually of silica, lime and alumina.

In the most durable kind of sandstone this cement is almost pure silica and in the weaker stones it consists quite largely of alumina or clay. Lime when present in this cement, renders the stone particularly liable to disintegration when exposed to an impure atmosphere, or when used for foundations washed by water containing acids capable of attacking the lime. The presence of clay (silicate of alumina) or of protoxide of iron is very injurious. Sandstones vary in quality between very wide limits, some being very hard; for example, the Vert Island Red Sandstone and other kinds being the most friable of our building stone.

The diamond saws of the Young & Farrel Company will cut through about eight inches of the Vert Island stone per hour, while they will cut through thirty inches of Amherst stone in the same time.

The strength and durability of the best sandstone, together with the ease with which it is worked, causes it to be extensively used, more so probably than either of the other kinds. The color varies greatly; light grey yellowish cream color, dark grey, bluish, and several shades of red to brown. It is often called "free stone" from the ease with which it is worked, though this name is applied to any free working stone. Water will pass between the layers of many sandstones which makes it important that such stone should be set on their natural bed, or large pieces may be scaled off. I have known front steps of brown stone to separate between the layers of stratification, so as to give a hollow sound when struck with the heel, and even to scale off over the entire surface.

There are several classifications of sandstone, many of which are, however, local. In Scotland, and to some extent elsewhere, *Liver Rock* is a term applied to the best and most homogeneous sand stone, which comes out in large blocks undivided by intersecting vertical and horizontal joints.

Flagstones are those which have a good natural cleavage.

Grits are coarse grained, strong, hard sand stone, from the millstone grit formation in which they are found. They can be obtained in large blocks, and are in consequence much used in heavy engineering work.

Micaceous Sandstone are those containing a very large proportion of mica distributed over the planes of bedding.

Calcareous Sandstone contains a large proportion of carbonate of lime.

Feldspathic Sandstone contains a large proportion of feldspar, generally derived from the disintegration of granite or other feldspathic rocks. The weathering qualities of these depend upon the quality of the feldspar.

Metamorphic Sandstone are those which have been subjected to heat. They make a fair road metal or McAdam

The recent fracture of a good sandstone will be bright, clear and sharp. The grains should be of fairly uniform size and well cemented together. This examination is best made with a magnifying glass. A dull, earthy appearance indicates a poor stone, not likely to weather well. The size of the grains is not important and of itself is no indication of the quality.

From the extreme north of Lake Superior in Nepigon Bay, we have:

The Vert Island Sandstone.—It is of the Old Red Sandstone or Potsdam formation, uniform in color, density and texture. The deposit is from 15 to 30 feet thick and covering 40 acres. It is a Liver rock, showing no signs of stratification. The microscope shows the stone to be composed of quartz and feldspar, with very little mica, and is of a close, compact texture.—*Merrell, Smithsonian Institute, Dept. Rocks and Building Stones.*

Analysis by C. F. Chandler:

Stands fire well; cubes heated to white heat and thrown

in water were but little affected. Crushing weight, 10,504 pounds per square inch.

Silica	83.14	Sand	69
Alumina	4.11	Feidspar	23
Potash	3.17	Carbonate of Lime	5
Soda	0.54	Oxide of Iron	3
Protoxide of Iron	2.86		
Lime	2.48		
Magnesia	0.30		
Moisture	0.20		
Unascertained	0.89		
	100		

Modina Red Sandstone, from New York, much resembling the Vert Island of Lake Superior.

Connecticut Red Sandstone, of much softer texture, more easily cut and can be used for carving rich mouldings, etc., where the harder stones would be too expensive. I have also a sample of the Red Scotch Sandstone known as Corse Hill, of good texture and bright in color. Berea, Millstone Grit, Amherst (grey) Sandstone, Euclid, Aux Sable, Minnesota, Columbia, Warrensburg, Mo., etc., etc., each having its special qualities, adapting it to some special use. The Vert Island is very hard, the Columbia is soft: some are dark, others of soft, light warm color.

Our last division is the *Limestones*. The name is applied to any stone that is composed in large part of Carbonate of Lime. They are attacked by strong acids which expel the carbonic acid, causing effervesence, and form new salts with the lime. The carbonic acid is also expelled by heat, forming oxide of lime, caustic lime or quick lime as it is called.

Limestones differ greatly in chemical composition, texture, hardness and other physical characteristics. While some are as strong as granite, others are as soft and friable as the weakest sandstone. Limestone is generally easily worked. There are two main divisions of limestone: the Granular and the Compact. Both yield excellent building stone, Limestones which take a smooth surface and fine polish are usually called marbles and are usually found in mountainous districts.

Common limestone is often found in immense strata as deposited on the bed of the ancient ocean.—*Thurston.*

The best weathering limestones are dense, uniform and homogeneous in structure and composition, with fine, even, small grains and a crystaline texture. Some limestones consist of a mass of fossils, either entire or broken up and united by cementing matter. Others are entirely made of round grains of carbonate of lime generally held together by cement of some material.

The Royal Commissioners of England gave preference to limestones as a class "on account of their general unanimity of tint, their comparative homogeneous structure and the facility and economy of their conversion to building purposes," and of limestones they preferred "those which are most crystalline." Many limestones are most easily worked when first quarried, and harden on exposure to the atmosphere. The cause is not well known. Small quantities of potash have been often observed in such stone and to this some French engineers attach considerable importance. Limestones are classified as Marbles, Compact Limestones, Granular Limestones, Shelly Limestones and Magnesian Limestones.

Any limestone is called a marble that is hard enough to take a polish. Their appearance varies greatly, from white to black, with all imaginable combinations of colors, some of the most beautiful derive their colored veins from the accidental introduction of metalic oxides. Many of the marbles used by the ancients and handed down to us as works of art, are not now known in their natural state.

Compact Limestones consist of lime either pure or combined with sand or clay. In general it has no crystalline structure and is of a dull earthy appearance. They are not much used as cut-stone, but make good rubble.

Granular Limestone consists of grains of carbonate of lime cemented together by the same substance or by some mixture of carbonate of lime, silica or alumina. These limestones are generally found in the oolite or eggstone formation. The grains vary greatly in size. In some they are very small and uniform, very few being of larger size. When the whole of the grains are somewhat larger, they constitute what is called *Roe-Stone*, the structure resembling the roe of a fish. When the grains are of the size of peas, the stones are called *peastones*. Nearly all of these stones contain fossil shells. In some cases the shells form more than half the stone, they are then called *shelly granular limestones*. The color of granular limestones is very variable. White, light yellow, light brown, bluish, etc. These granular limestones are generally soft and somewhat absorbent, and are liable to the attacks of acid atmospheres and frost but otherwise weather well. They afford some of the principal building stone.

Examples. The Bedford Stone, the Minnesota Stone, the new quarries of Delta Co., Mich.; one very hard another of a soft, warm salmon color, very useful.

Magnesian Limestone are composed of carbonates of lime and magnesia in variable proportions together with a small quantity of silx, iron and alumina. Many limestones contain a small quantity of magnesia, but those that contain less than 15 per cent. are not called magnesian limestones. There is a magnesian limestone known as *dolomite*, in which there is one molecule of carbonate magnesia, 54.18, to one of carbonate of lime, 45.82; in this proportion they seem to unite chemically and give some peculiarity to the crystals, which makes the stone exceedingly durable. Prof. Daniel states that the nearer a magnesian limestone approaches dolomite in its composition, the more durable it is likely to be.

Example. The most prominent is the magnesian limestone of Chicago, called variously, Athens Stone, Athens Marble, Chicago Limestone, Joliet Limestone, etc. It contains carbonate of Magnesia, 41.00; cabonate of lime, 36. Very near the proportion of Dolomite.

Analysis of Prof. J. V. E. Blaney.

Silica and clay insoluble in acids	17.33
Alumina	1.33
Carbonate of protoxide of iron	0.96
Carbonate of Magnesia	31.00
Carbonate of lime	36.00
Water	1.00
Alkalies (not estimated) and loss	2.38
Total	100.00

Tests by W. Shippen, of Smithsonian Institute.

Greatest crushing force to 1 sq. inch in lbs. avord.	22,301
Least " " " " " " " "	15,690
Average from seven specimens " " " "	17.309
Weights 180 lbs per cubic foot rough	
" 160 " " " " dressed	

Preservation of Stones. This question has of late years attracted much attention. Many methods have been proposed and tried but none have been all in all so satisfactory as to come into general use. Paint is effective for the short time it lasts, but disfigures any good stone, and certainly cannot be recommended. Oil fills the pores of the stone for a time, but discolors the surface.

There is a process that was applied to the building of Mr. L. Z. Leiter, occupied by Myers, Strauss & Goodman, Monroe and Fifth avenue. The surface is warmed by a charcoal stove, and then a hot solution of parafine and creosote is applied with a brush. The creosote tends undoubtedly to increase the durability of the parafine. This treatment is open to the objection of discoloring stone.

There is a process known as "the Lundberg," which is applied by a company in this city. The material is said to be an insoluble metallic substance. There is a stone in the Chicago Post-office, treated six years ago, that to-day appears better than any other stone in the building.

Some methods of preserving the stone in our city buildings is certainly very desirable. How many are so seriously discolored that whatever beauty they may once have possessed is lost. The Chicago Custom House and many other buildings of both limestone and sandstone have the surface scaled off over considerable areas.

While we are seeking a preservative we must not loose sight of one element of destruction, muriatic acid, which is very generally used in cleaning buildings. It is almost impracticable to prevent its use, so much does it diminish the labor.

We have hastily reviewed the different kinds of building stone and examined such specimens as I have been able to procure. I have by no means exhausted the subject. There is much more to be said, but probably I have said quite enough for one evening. It is easy to see that Chicago is not wanting in a variety of good building stone of all the species and of all colors, and if the architects fail to build both substantially and beautifully they certainly cannot excuse themselves on the ground of the want of material.

The Liverpool Engineering Society.

The fourteenth meeting of the session was held November 21st, at the Royal Institution, Mr. N. Bramall, M. Inst. C. E. in the chair. A paper entitled "The Velometer, Universal Governors and Compound Attachment for Controlling Low-pressure Cylinders," was read by Messrs. Durham and Churchill, of London. This was followed by an interesting discussion by the President, Messrs. R. R. Bevis, jr., T. F. Irvin and others.

A description of the new "Insulite Sealed Battery" was given by Mr. W. H. Fleming. He first pointed out the defects in ordinary batteries, such as loss of liquid by evaporation, which necessitates frequent supervision, the giving off of noxious vapors combined with the irrepressible "creeping": and then stated that an attempt had been made to minimise these serious disadvantages which had been crowned with success by The British Insulite Company of London, who have recently brought out a useful form of battery cell constructed of their special compound. Dr. Hopkinson, the well-known electrician, submitted the cells to prolonged and continuous tests, with the resulting opinion that this battery would supersede all the old-fashioned cells.

The annual meeting was held December 5th, at the Royal Institution, the President, Mr. Bramall, M. Inst. C. E. in the chair. The report of the Council having been made, the President congratulated the members upon the flourishing state of the Society, therein disclosed and moved its adoption, which was carried.

The following gentlemen were elected officers for next year: President, Mr. R. R. Bevis, jr.; Vice-Presidents, Messrs. J. S. Brodie and W. E. Mills; Council, Messrs. C. S. Pain, J. Moylan, A. J. Maginnis, F. Hudleston and J. Price. The present Hon. Treasurer, Mr. O. S. Pilkins, Hon. Librarian, Mr. W. H. Berwick, and Hon. Secretary, Mr. R. L. Tapscott, were unanimously re-elected.

The President, Mr. Bramall, then delivered an address on "Modern Progress in Mine Engineering," and said that the Americans had improved the Chinese method of boring deep holes by aid of a rope; that they had attained a speed of thirteen yards per day in Pennsylvania oil wells, while with the diamond drill perfect cores of the strata had been obtained from a depth of nearly 4,000 ft.

A great improvement is the flushing of the holes by a continuous stream of water; and this power in the Arlberg tunnel system has enabled 100 ft. to be bored in loose ground in a day. The adoption of power drills, varieties of which were noticed, with the powerful modern explosives, dynamite, etc., together with the electric firing of the charges, has enabled tunnels to be driven at a speed hitherto unknown. The danger attending the use of gunpowder in fiery coal mines, has led to the invention of many kinds of wedges and coal-cutting machines, and also the Lime system. Difficulties of water-bearing strata had been overcome by the Kind-Chaudron method, by which pits up to fifteen feet diameter were bored from the surface; and by the Pretsch system the wet ground was frozen into a solid mass, in the center of which the pit was dug out. Iron has been largely introduced for the support of roads underground and pits. The size of pits has been increased till we have some in England from 100 to 750 yards deep and up to twenty feet diam. fitted with coupled engines having two cylinders up to fifty-four inches diam. capable of raising a gross load of fifteen tons at a speed of easily thirty miles per hour. The numerous improvements in engines and winding appliances, for attaining safety and economy, electric signalling and the telephone, transmission of power to the interior of mines by electricity and compressed air, the adoption of direct acting pumping engines underground, gas-fired boilers, and the various mechanical ventilating machines by which underground furnaces have been superceded, were noted. A perfect safety lamp we unfortunately do not yet possess, and the inventions of Davy, Clanning and others, are in general use; the risk of the former has been reduced by the use of the "Tin-can" shield. The effort to render the electric light useful to the miner has not yet succeeded. Some improvements in the mechanical preparation of ores and utilization of small coal were briefly alluded to.

WASHINGTON, Dec. 28.—The report of the Mississippi River Commission gives a detailed statement of the work performed during the year and makes a number of recommendations for carrying on the improvement operations for the year ensuing. The financial statement accompanying the report give the estimates of funds required for the fiscal year ending June 30, 1884: For the improvement of the Mississippi river, below Cairo, $3,000,000; for the fiscal year ending June 30, 1885, for work on the New Madrid reach, $1,000,000; for work on the Memphis reach, $675,000; to continue the salaries and expenses of the commission for the next fiscal year, $200,000. The members of the commission signing the report are C. R. Suter, Henry Mitchell, B. M. Harrod, Robert S. Taylor, S. W. Ferguson.

A minority report is submitted by General C. B. Comstock. He says that the appropriation of $11,443,770 mentioned by the commission is too small for any adequate system of levees intended to prevent destructive floods (except at intervals of fifteen or twenty yards) to secure the property of the inhabitants behind them.

PROFESSOR THOMPSON in a recent lecture at Glasgow, said that the earth's magnetic pole was now more than 1,000 miles west of the geographical pole. The magnetic pole moving from a point to the eastward, reached the true north in 1657. Continuing westward, it reached its farthest limit in 1816. It is now moving eastward, and in 1976 the magnetic needle may be expected to point again due north.

MAYOR Palmer, of Boston, has issued a proclamation appealing to the citizens for the utmost economy in the use of water until the present prolonged drought shall have ended and the depleted reservoirs are filled by an abundant rain-fall.

WITH great ceremony the last stone was laid in the harbor of Trieste on Dec. 19. The work has taken fifteen years, and has cost over $7,000,000.

"Liberty Enlightening the World."

The elevation and sectional view of the pedestal and foundations for the above statue, published by us this week, are reduced from the official drawings in the office of General Chas. P. Stone, Chief Engineer of the Commission for the erection of the pedestal of this already famous monument. The foundation up to the "terrace" level is designed by Chief Engineer Stone, the cut-stone pedestal above that level is from the plans of Richard M. Hunt, Architect to the Commission. We are also indebted to General Stone for the accompanying data and for the privilege of using the plans referred to.

The drawing, which is made to scale, will sufficiently explain the general design and proportions of the statue, its pedestal and foundations. The site is the centre of the old Fort Wood on Bedloe's Island in the Harbor of New York, and this "star" fort will itself be utilized in the base of the monument, as shown in section on the drawing.

The material underlying the foundation is compact clay, gravel and boulders. No rock appearing in test holes sunk, for at least 35 feet below the bottom of the concrete base.

The foundation mass up to the "terrace" level is of solid concrete; it is 90 ft. square on the bottom, 65 ft. square at the top and 52' 10" high. This foundation is now in place to some little distance above the level of the floor of the "sally port" of the fort, about 5,000 cubic yards being laid. The concrete is mixed in the following proportions for the foundation proper, i. e., to the surface of the ground:

Two barrels Norton's Rosendale Cement,
Two barrels sharp river sand,
Three barrels small broken stone (trap),
Four barrels stone passing through a 2 in. ring,

or one part cement to four and one-half parts of sand and broken stone.

For the portion above the ground the following proportions are used:

One barrel Portland Cement,
One barrel Norton's Rosendale Cement,
Five barrels of sand,
Six barrels of stone, broken to pass through a one inch ring.

All cement is systematically tested, and the concrete is laid and rammed in 6 inch courses. About 200 to 250 barrels of cement are used each day. Smith, Magaw & Drake are the contractors for the concrete base. Four arched ways, on the parade level, lead from the sides of the base to the central shaft, which has been reduced to 10 ft. square instead of 16 ft., as shown on the accompanying plan. Surrounding the entire base and spanning the space lying between the inside walls of the fort and the sides of the base will be sprung a concrete arch, about 3½ ft. thick and of a chord span of 49 ft. This arch will be covered with earth and form the foundation for a grassy mound rounding up to the base of the ornamental stone pedestal; and it will also carry the four flights of stone stairways by which the "terrace" level is reached.

The pedestal proper is 62 ft. square at the base, 40 ft. at the top and will be 114 ft. high to the base of the statue. The central shaft in this portion of the structure will be 24 ft. square and is reached by two arched ways leading through the base from side to side. The material of the pedestal will be dimension cut-stone throughout, although the exact character of the stone to be used has not yet been determined upon, and will ultimately depend somewhat upon the bids received. Of the stone presented as specimens, granites, marble and a black compact limestone have been classed among those "acceptable." Since our illustration was made the architect has slightly changed some few of the details above the "loggia" floor and has also changed the dimensions of the base of the pedestal and its height from the dimensions given on the plan and elevation; these changes are noted in the text. The circular shields on the base will contain the coats of arms of the different States.

The plans for the anchorage of the statue to its base and the precautions to be taken against the leverage of wind pressure, are not just yet sufficiently advanced to be published with this sketch, but as this is a most interesting engineering feature in the design, we hope, through the courtesy of Gen'l Stone, to present the completed plans to our readers. At present we can only say that the iron anchorage rods will pass from the figure to the very base of the stone pedestal, throwing the entire weight of the mass upon them.

As of interest in this connection, we give some details concerning the statue of "Liberty" itself, taken from *Le Journal Illustre* of May, 1883.

M. Bartholdi, the designer of the figure, was born in Colmar, Alsatia; was a student at the Lyceum of Louis the Great; first studied art with Ary Scheffer, and at the age of 22 exhibited his first work, a statute of Gen. Rapp, also a native of Colmar. He took an active part in the Franco-Prussian war, and after the termination of that struggle executed his famous work of the Lion of Belfort. Ten years ago he conceived the idea of his statue of Liberty Enlightening the World, and enlisting the sympathies and aid of his countrymen, has pushed forward to a final and grand success the greatest statue of modern times. When his first model, known as the Committee Model, had been accepted, M. Bartholdi finished another study 2 m 11, or 6.9 ft. high from head to foot. This second model was increased four times, or made 27.9 ft. high and the effect studied, and after it had been remodelled and completed to the satisfaction of the sculptor, this third model was divided into sections; and finally each of these sections was enlarged again four times with mathematical care to serve as a model for the statue itself.

All the work has been executed at the shops of Messrs. Gaget & Gauthier, 25 Rue de Chazelles, Paris. M. Eisel was the engineer who designed the interior iron frame work and bracing, M. Simon had charge of the modeling department, M. Bargeret the copper work and mounting of the plates, and M. Baron superintended the wood work of the preliminary moulds. The general method of proceeding in the production of this enormous figure was as follows: Each section of the third model was marked out in points according to the usual method of enlargement employed by sculptors; about 300 principal points and more than 1200 secondary points being required for each section; and each point, usually a nail head, required six measurements, without counting those of verification, or about 9,000 distinct measurements to each section.

By this method of transfer a frame work was produced in wood, covered with laths and finally coated with plaster, of the full size of the statue, each section, however, being separate as in the original divided model. When a full-size model of any section was completed, the carpenters cut profiles in boards of the exterior of parts of the model, and then by placing the boards side by side formed a species of mould. In these wooden moulds the hammersmen then shaped the sheets of copper destined to form the exterior of the completed statue; this shaping was done by pressure with levers or by beating with hammers; the finishing was done by small hammers and by punching. The sheets of copper are backed at regular distances by forgings to give them stiffness, these forgings being first carefully fitted to a mould. For the smaller details, sheets of lead were pressed upon the model and the copper worked to fit them. The sheets of copper are finally attached by the interior ribs, straps, and forgings to a strong four-sided iron frame work which occupies the centre of the figure, and which will in itself be firmly anchored to the masonry of the pedestal.

The copper sheets used are 2½ millimetres, or about one-eighth of an inch thick. The entire weight of the figure is about 440,000 lbs. (200,000 kilos.) of which 176,000 lbs. (80,000 kilos.) are copper and the remainder wrought-iron.

The following are some of the dimensions of the completed statue:

Base of figure to top of torch,	(46m. 08)	151.14 ft.
" " " diadem,	(35m. 50)	116.44 ft.
From he heel to the top of the head	(34m.)	111.52 ft.
Length of index finger	(2m. 45)	8.03 ft.
Circumference of same at second joint	(1m. 44)	4.72 ft.
The finger nail is	(0m. 35x0m.26)	1.14x.85 ft.
Height of head	(4m. 40)	14.43 ft.
Width of eye	(0m. 65)	2.13 ft.
Length of nose	(1m. 12)	3.67 ft.

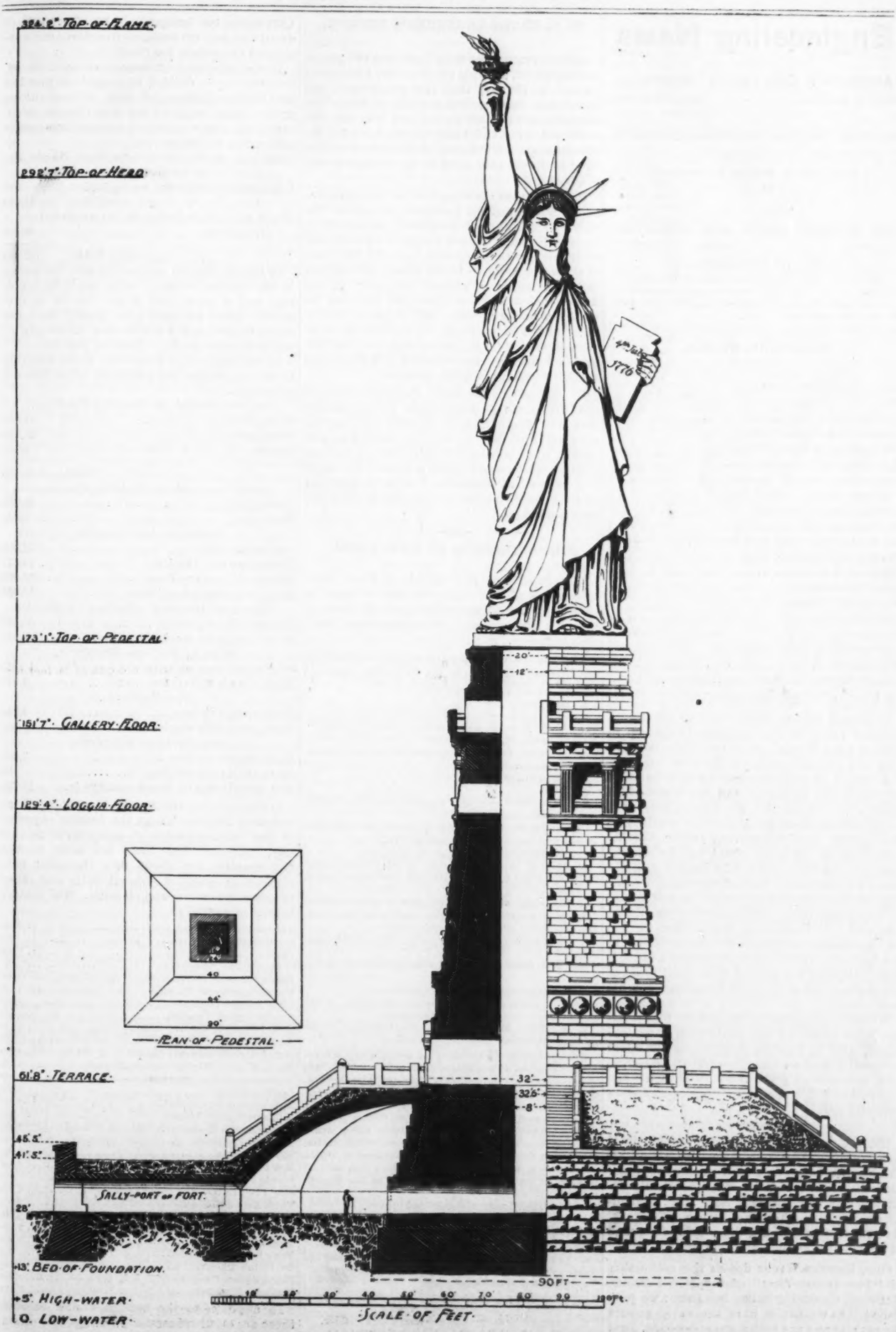
At the Paris Exhibition of 1878, forty persons at one time could find standing room within the head, and twelve persons can stand together in the torch above the hand, access to which is obtained through the arm.

For the purpose of transportation to America the statue will be divided into 300 distinct parts.

THE WASHINGTON WATER-WORKS.

The work on the new reservoir at the head of Sixth street is progressing rapidly. There are 170 men and 160 horses and carts daily employed. Up to date between 70,000 and 80,000 yards of excavation have been made, which is used in the construction of three dams. The work will be finished sooner than the contract calls for, and so far the engineer department has expressed satisfaction with the progress made. Work will be kept up, weather permitting, and operations will soon be begun on the conduit. Stables have been built for 100 horses. Blacksmith shops, feed house and a large commissary department have been erected. The laborers are paid every two weeks at the rate of $1.25 per day. There will be sixty-seven acres in the reservoir when completed. It will be star-shaped, with a depth of 30 feet for waste, which will throw water 55 feet higher than any portion of the level of Capitol Hill. There are three dams to be built. The largest is at the south-east point of the reservoir, and it is to confine the water in that receptacle. A smaller one will be near the Soldiers' Home, and will run in a northwesterly and southeasterly direction, and the third will be near the Schuetzen Park, running from east to west. These small dams are to cut off all surplus water from running into the reservoir, as none but Potomac water will be allowed to flow in. So far there has been no obstacle to overcome, as was at first feared, and the contractors, Messrs. Maloney and Gleason, express themselves as thoroughly satisfied with the progress they are making. There is still a large amount of masonry, brickwork, excavation and concreting to be done on the reservoir, and from the statements made it is supposed that matters will be kept going all winter with the largest force possible, if the weather permits and it is found advisable by the engineer office. On the West Washington end the contractors, Messrs. Quakenbush and Beckwith, are showing a decided enterprise. Work has already commenced there with a large force, and shafts are being sunk, buildings erected for every purpose, and machinery is daily arriving. The progress made so far at that end is an index of the speedy completion of the work.—*Govt. Advertiser.*

WASHINGTON, December 26.—In his report to the Secretary of the Interior of the operations of the United States Geological Survey during the month of December, Director J. W. Powell expresses his gratification at the progress made. The geological and topographical parties sent out during the summer have nearly all returned and are engaged in writing out notes and compiling the results of their labors. The party under Professor Gove, which was engaged in a topographical survey of the South Atlantic district, have about concluded that work. The New England party will be kept in the field during the winter, if practicable. Progress is also reported in the survey of Rocky Mountain district. Material for a report on drainage and forestry has been collected by Mr. Schutt. The director thinks well of the plan adopted by Secretary Chandler of detailing junior naval officers to assist in scientific work and says it has worked satisfactorily.



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It is with sincere regret that we reprint, in another page, the announcement conveyed in "Some Last Words" from one of the late editors and proprietors of the *Railroad Gazette*.

As the chief spirit in founding and building up one of the strongest and most successful class papers of the day, Mr. Forney places too modest an estimate upon his own services to the railroad and engineering public. In his own work he certainly could not be classed among the uninformed and hesitating, or timid editors he refers to; with a thorough knowledge of his subject he said what he had to say in words that none could misunderstand, and was bold and fearless in denouncing wrongs and suggesting reforms in all that pertains to the railroad world. His declining health, if other evidence was needed, is in itself proof of the tireless zeal with which he carried out his task.

We know somewhat of the severe and ceaseless labor attending the production of a class paper, and in bidding farewell to our warm personal friend and brother editor, we couple with our sympathy our earnest wishes for the renewed health he seeks in rest from unceasing editorial toil.

MR. BELL, the new Surveying Architect of the Treasury Department, has dismissed all the French employees who monopolized the modeling room, because they practically excluded the English language and English-speaking persons from that branch of the work. He prefers men who use the official language of the country employing them.

GEN. HERMAN HAUPT denies the authorship of "The Inside View" of the North Pacific Railroad, appearing in our last issue; we published it as we found it in the daily papers He says he was not within 500 miles of St. Paul at the time of the alleged interview.

N. Y. STATE ENGINEER'S REPORT.

Silas Seymour, the New York State Engineer and Surveyor, sent his report to the legislature on Jan. 2. He says that the condition of the canals has deteriorated instead of being improved, since his last report, and it would cost $3,502,443 to put them into thorough repair. He recommends the building of a reservoir at the head of Forest Port pond at an estimated cost of $40,000.

He states that the long level of the canal between Rochester and Lockport, as well as the shorter levels east of Rochester, are silting up by side drainage to such a degree as seriously to interfere with navigation and the full flow of the water required in the canal. He advises the construction of storage reservoirs in the Adirondack mountains, which he says can be built at a moderate cost. Mr. Seymour has serious doubts of propriety of expending large sums of money for the preservation of the Adirondack forests. He estimates that $50,000,000 would be required for this purpose.

In conclusion, the State Engineer believes that the canals, as a successful and necessary means of transport, have outlived their usefulness, and also that as between railroads and canals, when considered with reference to their relative merits as affording a means for rapid and economical transport, it must be regarded as a foregone, inevitable conclusion that the canals must go.

THE BUILDINGS OF NEW YORK.

The report of the Board of Fire Commissioners of New York for 1883 informs us that there are 107,300 buildings of all kinds in this city now occupied for residence and business purposes.

The general classification adopted in making out this tally is given in the following outline:

1.—As to their uses, subdivided into—

a. Dwellings exclusively.

b. Dwellings principally and partly business, &c.

c. Dwellings partly and principally business, &c.

d. Business, &c., exclusively.

e. Sheds, &c., detached from other buildings of occupants of premises.

f. Bridges over streams, cuts, &c.

g. Piers.

The term "business, &c.," includes every use except that for dwellings.

Under the head of "sheds, &c." are also included gasometers, large oil tanks, magazines, &c.

2—As to their construction, subdivided into—

a. Built of brick, stone, iron or other non-inflammable materials, except as to flooring, trimming, sashes, doors, &c.

b. Walls built of brick, stone, iron or other non-inflammable materials; floorways, partitions, stairways, &c., of wood or other inflammable material.

c. Built mainly of wood or other inflammable material.

The first class (*a*) is the so-called fireproof structure.

3.—As to their height, subdivided into—

a. Four stories or less above the basement, or the ground floor where there is no basement.

b. More than four stories above the basement, or the ground floor where there is no basement.

Want of time not permitting the actual measurement of the heights of buildings they were divided into classes as above. In the first of these (*a*) there are few, if any, the top floors of which are inaccessible with the longest fire ladders; and the second (*b*), while in the main representing buildings the upper stories of which are not accessible by ladder, also contain many structures of five, six or even seven floors, which as the stories are more or less below the standard of height adopted as a basis for the classification, can also be reached by the longest ladders in use in the department.

4. As to their location, subdivided into—

a. On the street—*i. e.*, having no other buildings between them and the highway.

b. In the rear of other buildings.

5.—As to the number of families in buildings used exclusively principally as dwellings, subdivided into—

a. Occupied by one family each.

b. Occupied by more than one family each.

c. Occupied by one family on any floor.

d. Occupied by more than one family on any floor.

Out of the 107,300 structures, which include 4,231 sheds, 144 bridges and 301 piers, only 65 dwellings and 120 business structures are considered absolutely fire proof.

In the tabulated statement given in the report the city is divided into thirteen districts and the result given for each; without taking up the space required for this minute subdivision we give a series of general summaries embracing the whole city.

Buildings as to their constructions (sheds &c., not included).

Inflammable material exclusively	185
" " and wood, &c	73,641
Wood and other inflammable material exclusively	28,798
Aggregate Total	102,624

In the 8th district which includes the homes of our wealthy citizens there are 9,990 buildings, and of these only 47 are classed as fireproof. There are also 6,350 shoddy flats and other houses and 2,966 wooden structures of which 1804 are used for dwelling purposes.

In the entire city there are 78,693 dwelling houses the rest of the buildings being devoted to business.

Buildings used for Dwelling Purposes.

Exclusively	49,565
Principally	26,280
Partly	2,523
Total	78,368

Buildings used for Business Purposes.

Exclusively	24,256
Sheds, &c	4,231

Dwellings—how occupied.

One family each	32,096
More than one family	10.314
One family on any floor	16.992
More than one on any floor	18.966

Height of Dwellings Fronting on Street.

Four stories or less	69,427
More than four stories	3,742

Height of Business Structures.

Four stories or less	15,583
More than four stories	3,278

Rear Dwellings.

Four stories or less	4,834
More than four stories	365

Rear Business Structures.

Four stories or less	5,331
More than four stories	64
The grand total of rear buildings is	15,798

Accompanying the report is some very interesting information as the seating capacity of the various places of amusement in this city, showing that there are seats in the city theatres for about fifty thousand people, not to speak of concert halls and other places of recreation and pleasure. The matter is thus presented:—

Academy of Music	2,180
Bijou Opera House	612
Casino	1,061
Cosmopolitan Theatre	1,350
Daly's Theatre	965
Fourteenth Street Theatre	1,800
Fifth Avenue Theatre	1,346
Grand Central Theatre	1,150
Grand Opera House	2,113
Haverly's Comedy Theatre	627
Harry Miner's (Bowery) Theatre	2,273
Harry Miner's (Eighth Avenue Theatre	2,240
Lexington Avenue Opera House	1,000
London Theatre	1,500
Metropolitan Opera House	2,300
Madison Square Theatre	627
Mount Morris Theatre	1,076
National Theatre	850
Niblo's Garden	2,060
New Park Theatre	1,500
People's Theatre	800
Star Theatre	1,249
Third Avenue Theatre	1,100
Theatre Comique	1,426
Twenty-third Street Theatre	1,200
Thalia Theatre	1,558
Tony Pastor's Theatre	613
Turf Club Theatre	640
Union Square Theatre	1,184
Wallack's Theatre	1,133

In addition to the buildings now erected there are on file plans for dwellings to contain 10,174 families, or over 50,000 persons.

ELEVATED ROADS FOR BROOKLYN.

On Dec. 29, the Brooklyn Board of Aldermen granted a charter to the King's County Elevated Railroad Company.

A number of conditions are attached to the consent granted, which if they remain unfulfilled, render it inoperative. The consent of a majority of the property holders on the route proposed must first be obtained, and these owners must be compensated for any damage done to their property. The work of construction must commence upon one or more of the routes on or before Sept. 1, 1884, and the road must be completed and in operation two years thereafter under penalty of the grant becoming inoperative and nugatory, as far as it refers to such portion of the road as shall be unfinished at that time.

Five years after the first road is in operation the company will be required to pay into the City Treasury 2 per cent. of its gross earnings each year. Any time after the construction of the roads the company must give the right-of-way to the Fulton and Broadway ferries and to the bridge to any other company authorized to build and operate elevated roads the lines of which intersect those of the Kings County Elevated road at any point within one mile of the bridge or ferries upon such terms as may be agreed on between the companies, or, in case of disagreement, upon such terms as may be fixed upon by the Commissioners appointed by the General Term of the Supreme Court.

The last condition attached to the consent is that the company shall pay into some New York or Brooklyn Trust Company designated by the Mayor of Brooklyn "so many of the bonds of said company, forming part of the issue of its bonds that shall be secured by a mortgage that shall be the first lien upon the companies' properties, rights, powers, privileges, and franchises, as shall have the par value of $1,000,000, with all coupons or warrants for interest thereto attached that shall mature subsequent to Sept. 1. 1886." The company may elect to deposit instead 75 per cent. in cash of the par value of the bonds. At the completion of each mile of road the company is to receive back $100,000 of such deposit, the object of the deposit being to secure the city against damage should the company fail to fulfill its part of the contract.

THE PANAMA CANAL.

The condition of work to the end of October, is thus given in the last number of the *Bulletin du Canal Interoceanique:*

Colon.—The terre-plain is finished; nearly 20,000 cu. yds. of earth have been deposited here during the month, and 2,071 tons of stone blocks have been used in rip-rapping. The tracks upon the terre-plain have all been finally laid except two. The new hospital for strangers was opened on October 5th. This building contains twenty beds, a pharmacy, etc. The dredge of Messrs. Huerne, Slaven & Co., has been at work since October 8th, and has proved most satisfactory. Up to the end of October it had removed about 93,300 cu. yds. of material. Dredges No. 2 and No. 5 are still at work in the Fox River. These two dredges have moved during the month, 27,800 cu. yds.

Gatun.—Dredge No. 3 is at work on the ditch of the canal between Chagres and Gatuncillo. The trench opened is 500 ft. long, about 75 ft. wide, and 15.ft. deep, below the sea level; the cube extracted amounts to 22,700 cu. yds. Dredge No. 4 is at work on the Weisler & Legrot contract in the rear of Gatun and west of the canal.

Buhio Soldado.—The two drainage ditches on the right and left banks are finished, and the roads pushed to the abutments of the new bridge. Work is in progress on the canal between Kilometres 23.9 and 24.3.

Tabernilla.—In this section the work of arranging for camps and workshops has been continued.

San Pablo.—The principal way of access to the canal on the right bank of the Chagres is finished.

Gorgona.—Of the 33,000 cu. yds. removed in this month in this section, 17,000 yards was taken from the Matachin hill. At Bas-Matachin and at Santa Cruz, 10.000 cu. yds. of material have been moved.

Obispo.—The Bona contractors have removed 24,700 cu. yds. between Kilometres 45 and 45.850, and built the greater portion of their way of access. The Muraccioli contract has produced 3,600 cu. yds. in the month, entirely rock.

Emperador.—Of the cube of 43,000 cu. yds. removed here, 28,000 yards were rock.

Culebra.—Besides the two American excavators working on grade 95, another has been put into operation on grade 85; 750 cu. yds. per day are expected to be moved during the dry season.

Rio Grande Superieur.—The way of access to the Cerro Culebra is built to grade 40, and the hill is entirely denuded of wood upon those parts included within the lines of operation. Surveys for the changes in the course of the Rio Grande are being actively pushed.

Paraiso.—The contractors working between Kilometres 58,569 and 59,417, employ 150 workmen in arranging the camps and building ways of access.

Panama.—Ground has been prepared at the central hospital for new buildings. The construction of the new hospital for strangers advance rapidly. The line of the canal has been definitely surveyed and staked out. The cross-sections will be delivered in November to the Franco-American Trading Co. The first dredge for this contract was launched on October 25th, and the second and third dredges are now being put together in the shops of the company.

The Improved Sewerage System of Boston.

The Improved Sewerage System of Boston, which was put into practical operation this week, is in many respects one of the most remarkable engineering feats of the time, and has attracted the attention of prominent engineers in this country and the Old World, several of the latter have personally examined the works; even French engineers admit that the Boston system takes precedence of the famous works of Paris.

The project was conceived several years ago by Mr. Joseph P. Davis, then Chief Engineer of the city, and his plans were endorsed by a commission composed of E. S. Chesborough, C. E., Moses Lane, C. E., and Charles F. Folson, M. D. Mr. Davis visited and personally examined all the great systems now in use in Europe before finally settling upon the plans carried out.

The primary object of the plan, in brief, was to intercept the sewage of the city as it flows in the existing sewers and convey it to a point where it may be discharged with safety to the public health and with the least injury to other interests. The intercepting sewers follow the marginal streets of the city as far as practicable, that the sewage may be intercepted near the outlets of the existing sewers.

Without going into all the details of the routes of the intercepting sewers, which can only interest Bostonians, we will recapitulate the general scheme as continued from the main sewer leading to the pumping station and publish the following brief account as given in the *Boston Herald.*

"The main sewer begins at the corner of Camden street and Huntington avenue, but at some future time it will be continued through the Back Bay Park and Brighton avenue to Cottage farm. From Huntington avenue the main sewer follows Camden street, Washington street, East Chester park and its extension to Clapp street; thence it follows Clapp street a short distance and then crosses private lands to the corner of Boston and Mt. Vernon streets; thence it passes through Mt. Vernon street to the Old Colony Railroad, and proceeding in a direct line across the Calf Pasture Flats to Old Harbor Point, terminating there in a pumping station. At this point extensive works have been erected, the first of which is a filth hoist, through which the sewage passes before it reaches the pumping station. The filth hoist consists of five chambers, in four of which are hung, so as to be raised and lowered by winches, open cages, through which the sewage flows and which retains any large floating objects that would injure the pumps. They are arranged in pairs, one behind the other, so that one may be in place while the other is drawn up for cleaning.

"The complete design for the pumping station consists of an engine house, two boiler houses and a coal house, arranged on the sides of a square, or inclosing a court yard. They are of dimensions to contain eight engines with their boilers and appurtenances. Only a portion of those buildings have been erected, but they are so designed as to readily admit of extension. Four engines each of a capacity to raise 25,000,000 gallons in twenty-four hours to a maximum height of 43 feet, are now in position.

"About 200 feet southeast of the engine house the outfall sewer begins and extends to the reservoir on Moon Island, a total distance about 13,750 feet, or 2.6 miles. It is divided into three sections, known respectively as the tank or deposit sewer, the tunnel under Dorchester Bay, and the large sewer from Squantum Neck to Moon Island. The deposit sewer is about 1,200 feet long, and is carried upon an embankment extending into the bay to the west shaft of the tunnel. Its elevation is such that sewage will flow from it to the reservoir by gravitation. The tunnel, with its west shaft forms an inverted siphon passes under the navigable waters of Dorchester Bay. Its horizontal length is about 6,970 feet, and the average depth of the shafts below mean high tide is 145 foot to the bottom of the tunnel. The siphon has first a vertical descent of about 150 feet, next a nearly horizontal stretch of about 6,070 feet, and lastly a rising incline of 1 foot vertical to every 6 foot horizontal. It is not intended that any heavy material shall enter the siphon, as there is ample opportunity for all such matters to settle out of the sewage in its sluggish flow through the deposit sewer; but should deposits occur they can be easily removed or flushed out by using the deposit sewer as a flushing tank to aid the engines in producing and maintaining a high velocity. The four engines alone, running at full capacity, will give a velocity in the tunnel of 3½ feet per second.

"At Moon Island, where the sewage is discharged into deep water, there is a large reservoir covering several acres. It has four apartments and will hold nearly 25,000,000 gallons. Its design is such that it can be conveniently enlarged at any time to double this capacity to meet the needs of the increased growth of the city. The London reservoirs are covered with brick arches and earth, but it is hoped and expected that it will not be found necessary to cover this one. As a precaution, however, foundations for columns have been built, that a wooden covering may be put on if experience should prove that one is needful. A large number of gates are provided for admitting and discharging the sewage, which are to be opened by hydraulic pressure, as are those at the pumping station.

"The last link in the extensive chain of works is the outlet section, which contains four sewers, so arranged as to connect with the outfall sewer in receiving the discharge from the reservoir and carrying it out to the tidal current at the end of Moon Island.

"The drainage from buildings and the streets will be received by the existing sewers as heretofote; from these it will flow into the intercepting sewers, thence into the main sewer, and by it conveyed to the pumping station. Here it will arrive at a level of about 11 feet below low tide, and will be raised by the pumps an average hight of about 35 feet, that it may flow by gravitation through the outfall sewer to the reservoir. It will accumulate in the reservoir during the time of one tide and discharged into the harbor in the two hours after the ebb tidal currents are established.

"During the time the sewage is stored much of the matter in suspension will settle to the bottom of the reservoir. It is the intention to sweep this deposit into the harbor by the action of the discharging currents, aided by mechanical means; but should this be found objectionable, it may be hoisted out and deposited on the land. As, however, its specific gravity will be but little greater than that of water, as it will consist almost entirely of destructible material, it is thought no serious injury will be caused by its discharge into tidewater.

"The total cost of the work to the present time has been $4,544,272,89, and as but little more remains to be done, that amount can be said to represent the actual cost.

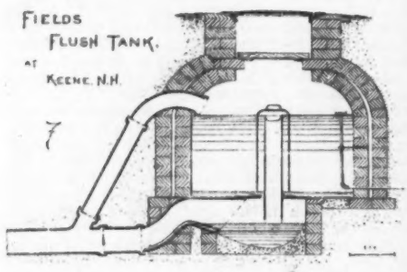
THE SEWERAGE OF KEENE, N. H.

From a report by L. M. Muzzey, engineer in charge, published in the *American Architect*, we make the following extracts:

The present population of the city of Keene is about 8,000. In 1882 Col. Geo. E. Waring devised a plan of sewerage, substantially the same as employed by him at Memphis, Tenn. Mr. Waring's plan was adopted by the City Council August 21, 1882, and the sum of $85,000 was appropriated to carry out his scheme.

The plan called for 8,800 ft. of 15 in. sewer, 1,950 ft. of 12 in. sewer, 1,248 ft. of 10 in. sewer, 530 ft. of 8 in. sewer, 60,520 ft. 6 in. sewer, all being pipe sewers.

The flush-tanks used with this system, are the Field flush-tank, and as they have been so much talked of lately, we give an illustration of the kind used at Keene.



These tanks have a uniform capacity of about 150 gallons; on account of the severity of the climate it was deemed expedient in this case to have a double brick wall with air spaces between.

The contract price per foot for laying the sewer-pipe, all material being furnished by the contractor and work done in accordance with the specifications, was as follows:

For 15 in. pipe	$2.05	per ft.
" 12 in. "	1.61	"
" 10 in. "	1.34	"
" 8 in. "	1.06	"
" 6 in. "	.90	"
Each flush-tank complete	$ 63.00	
" manhole, "	40.00	
" outlet, "	200.00	
" inlet, "	100.00	

The works are now so far complete that 720 families now have access to the sewerage system.

COLUMBUS, O. SEWERAGE.

Two large main trunk sewers have just been completed in Columbus, Ohio. They are known as the northeast and northwest sewers, and together amount to four and one-half miles in length. The size inside is from six to nine feet. The contractor for both is the Columbus Paving Co. Mr. N. B. Abbott, formerly of Brooklyn, is President and Manager of the company. On some parts of the work great difficulties were encountered. A mile of the northeast sewer was in a cut of from 25 to 32 ft. Nearly all of this deep cut had very bad quicksand bottom. At times two six-inch steam pumps were required to keep the ditch clear of water. On the northwest sewer, at one point, twenty railroad tracks and a large railroad shop were tunneled under. The work was completed several months ahead of the time required in the contract, and without serious accident of any kind. Two of Carson's excavators were used; one an eight and one a sixteen traveller. The work done by these machines was very satisfactory. Mr. Abbott reports them to be the most economical and efficient machines known for large sewer trenches. The magnitude of this contract can be appreciated by the following figures: 240,000 cubic yards of earth were excavated; 12,500,000 brick were laid, and all were made by the company in their own brick yard. Twenty thousand barrels of cement were used, and $185,000 was paid out for labor. These sewers run through the suburbs of Columbus, and form the basis of a very complete system of drainage. Lateral sewers will now be built in great numbers and street improvements will rapidly follow.

SOME LAST WORDS.

[From the *Railroad Gazette*.]

The announcement which is published in this number of the *Railroad Gazette* will inform many of its readers that one of its editors, who has been connected with the paper since 1870, will retire from the ownership and editorship on the first of January.

That the ending of a relationship like that which has existed for more than thirteen years between the writer and his readers should be the occasion to him of some regret is perhaps natural, although it is quite possible that they may not share this feeling with him, and the recollection of the way in which his weekly duty was often performed gives to that supposition a potential probability. Fortunately for editors, not all who take a paper have learned the art of reading between the lines, especially between the lines on technical subjects. The observant and careful reader can often observe a great deal more than is expressed in the printed words. Such a reader can often detect the limitations of the knowledge of a writer by his hesitation and indecision, or by the cautious way in which his opinions are qualified and limited; or he will notice how insecurely he has grasped his subject by the feeble way in which it is discussed. Repetition will show that the writer has quite gone over the area swept by his mental tether, and the manufacture of intellectual bricks without straw will be indicated by the crumbling character of the structure built with them. Narrow prejudice and partiality act on the mind like the reflector of a locomotive headlight on its lamp, throwing the rays of light in one direction only, and ignorance leaves its purposeless track in the mud of commonplace phrases. That there is an excess in the weekly demand of a paper over the supply of knowledge of its editor, is revealed by his being a borrower of ideas and a debtor to his contemporaries.

All of these faults and deficiences, and many others, besides, the readers of the *Railroad Gazette* have no donbt often observed in the work the writer has done for it.

But there are some transgressions and errors which have been resisted, with what success the readers of the paper must judge. He nas never assumed that railroad companies can do no wrong, nor has the authority to grant free passes been permitted to blind his eyes or pervert his judgment. Commendation of inventions, manufactures or persons has not been a commodity offered for sale.

That employees in demanding higher wages were not always wrong, and that companies in refusing to pay them were not always just; and that among the rights of employees which employers are bound to respect is that of a fair hearing and consideration of such demands, when properly made, has always been insisted upon. Much time and discussion has been devoted to calling the attention of railroad managers to the dangers to which their employees are exposed, and to inducing those who control such matters to provide appliances which would diminish the risk of those for whom so few are ready to speak. That the State should establish an authority to stand between the public and the railroad companies, to see that there is fair play on both sides, is a doctrine that the writer has always advocated, and the need of having railroad accidents investigated by some competent authority, which would represent the interests of the whole public, has been pointed out again and again.

During all of the thirteen years past, the *Railroad Gazette* has stood almost, if not quite alone, in the position that the arguments showing that the cost of constructing and operating narrow-gauge roads is essentially less than standard-gauge roads of a like character are fallacious and that the advantages claimed are illusions. In season and out of season the value of scientific knowledge in conducting the operation of railroads, and the importance of practical experience in applying it have been urged upon the managers in these columns.

The value to railroad companies of the work which such associations as the Master Mechanics' and Master Car-Builders' have done, and could do, has been dwelt upon, repeated and elaborated, until doubtless it became wearisome by repetition. In a valedictory, like this, it may not be out of place to point, for perhaps the last time, to the enormous economy which is possible if railroad companies would only organize a proper bureau of standards for rolling stock, and endow it with the means and the authority required to do the work. Out of uniformity and more skillful design a saving would result which could be counted by hundreds of thousands of dollars. The apathy of railroad managers in this respect is remarkable, if, at the same time, we regard their readiness to expend large sums in litigation, and in the maintenance of associations to resist the payment of unjust patent royalties. Show a railroad company that an inventor is likely to get more than his due and all its legal artillery will be opened on him, at any cost of ammunition, but there is much indifference to the loss and waste which is a consequence of the present diversity of rolling-stock, and to the disgraceful confusion which prevails in matters like the gauge of track and wheels and the form and meaning of signals, where the absence of a standard system means ever-present danger.

The remark that reforms move slowly is perhaps not accurately true. That reforms are slow to *begin* to move would perhaps be more correct. Like the launching of a ship, it is the start which is most difficult. If that is once accomplished, and if the ways are well lubricated, the end is accomplished so quickly as to astonish all who look on. That some reforms in railroad management have been hard to start should perhaps not cause surprise nor disappointment. Should they be launched hereafter perhaps it may be true that some of the work done during the past unlucky number of years may have helped to grease the ways, and thus may aid the reformatory measures in moving easily into the ocean of the future.

The work of editing a journal like the *Railroad Gazette* is not only severe but unremitting. Every week brings its work, and there is no opportunity for recuperating exhausted energies, however serious the need may be. But without health all qualifications go for naught. An editor is somewhat like a locomotive in this, that both will pull a good load if they only make plenty of steam. Even if the valve-gear is defective, the packing leaks, or if there is lost motion in the boxes, still with plenty of steam the machine will get over the road in some fashion; but when the boiler will not consume its fuel, or supply vitality, then skill, science and ingenuity all fail in doing any good—the machine, whether a locomotive or an editor, cannot then do full work.

Thus it has happened, when it became apparent that the editorial steam-gauge could no longer be kept up to the working pressure, that the question had to be decided whether it would be wisest under these circumstances to diminish the loads and continue at work until the mechanism was fit only for the scrap heap, or whether it would be best to uncouple from the train entirely, and lay up for thorough repairs. The latter plan is the wisest course to pursue with locomotives, and is the one which the master mechanic who superintends the repairs to the writer insisted must be adopted in his case, or the machine would soon be too dilapidated for any future service.

And thus, a career commenced with much hope, pursued with more than a little toil, is ended with some disappointed anticipations, but with many pleasant and some tender recollections. During that time friends have increased in number and ardor; the earnest discussion of subjects in which others are concerned has constantly given fresh interest to life and its problems, and the memory of some who have gone before still remains. The surrender of the editorial reins will bring much needed relief from incessant labor, and if health is granted will give time for research and work of a kind which it is impossible to do with one hand on the throttle and the other on the reverse lever of a weekly paper. Although shutting off steam for the last time is attended with some autumn-tinged reflections, yet it brings a present feeling of relief and the prospect of relaxation in the future, and therefore the step has commended itself to the writer, as he hopes it will to his readers, as a wise measure.

It remains but to come down from the footboard, to surrender the machine to its future runners, and to wish the readers of the *Railroad Gazette* a Happy New Year.

M. N. FORNEY.

THE Supervising Architect of the Treasury has completed plans for the Government buildings at Quincy, Ill., Peoria, Ill., and Columbus, O., and will soon advertise for proposals for construction. Preparations are being made for the erection of new public buildings at Terre Haute, Ind.

PERSONAL.

HENRY VILLARD is said to have resigned the position of president of the Northern Pacific R. R. Co His resignation was to be acted upon at the meeting of Jan. 4.

DR. J. MORRISON of the Nautical Almanac Office, Washington, has been elected a Fellow of the Royal Astronomical Society of London.

GEN. HERMAN HAUPT has accepted the Presidency of the Dakota & Great Southern R. R., 430 miles long, running from Grand Forks to Sioux City.

O. H. BUCKMAN, City Surveyor of Napo, Cal., is now engaged upon a system of water-works for his city. They are nearly completed; the Napo City Water Company is constructing them.

Mr. T. E. CALVERT has been appointed General Superintendent of the Burlington & Missouri River Railroad in Nebraska. He will also continue to act as Chief Engineer.

J. W. JONES, President of the Buffalo, New York & Phila. R. R., declines re-election for the coming year. He gives failing health as a reason for this action, and starts for Florida this month.

EDWARD P. NORTH has resigned his position of Vice President and General Manager of the Sinaloa & Durango R. R., his resignation to take effect from Dec. 31, 1883. Mr. North's address for the present will be No. 127 E. 23d St., New York.

C. C. LAMBERT has been appointed General Western Passenger Agent of the New York, West Shore & Buffalo Railway, with headquarters at Chicago. Mr. Lambert heretofore represented the Troy and Boston and Fitchburg Railroads in a similar capacity.

GEO. W. MCCRARY, Judge of the Eighth U. S. Judicial Circuit, has forwarded to the President his resignation to take effect March 1st. Mr. MCCRARY will become General Counselor to the Atchison, Topeka & Santa Fe Railway Co., with headquarters in Kansas City.

MR. J. Y. SAGE has been appointed General Superintendent of the Georgia Pacific Railway in place of G. J. FOREACRE, resigned, the appointment to take effect January 1st, 1884. Mr. SAGE will also perform the duties of Superintendent of the First Division (Atlanta, Ga., to the Warrior River, Ala.)

J. D. LAYNG has been appointed general manager of the New York, West Shore & Buffalo Railway, to fill the place of Charles Paine, who has gone to Europe for the benefit of his health. Mr. Layng has been general superintendent of the Chicago & Northwestern Railway for the last two or three years, an office which he resigned to take the present position in the West Shore management. Before that he was in the service of the Pittsburg, Fort Wayne & Chicago Railway for about fifteen years, rising to be general manager of that road.

E. C. DAVIS, C. E., of Springfield, Mass., has gone to New Orleans in the interest of the Mississippi river ship canal company, with plans which he has been working on for some months for ship locks, gates, etc. It is proposed to cut a canal from Lake Borgne to the Mississippi river, a distance of 12 miles, for the coast trade east of New Orleans, so as to avoid going down the Gulf and up the river, a distance of 265 miles. The Lake is one foot below low-water mark on the Mississippi river and the canal will cost about $450,000, the locks being 350 feet long. Mr. Davis is consulting engineer, and J. H. Gardner, brother of Architect Gardner, Springfield, is supervising engineer.

FRANK F. ALLEN was appointed, Dec. 29, Superintendent of the St. Louis Division of the Toledo, Cincinnati & St. Louis R. R., with headquarters at Charleston, Ill. Mr. Allen is a native of Syracuse, N. Y. Twelve years ago he began life as a telegraph operator, and obtained his first experience in railway work in the employ of the Lake Shore at Lake View, when he did duty as a night operator. Soon after he entered the dispatcher's office in this city and remained there until April, 1874, when William P. Taylor, who was then superintendent of the Buffalo division, made him his confidential clerk. When Mr. Taylor became general manager of the Canada Southern, he appointed Mr. Allen his private secretary, and continued him in that capacity after being assigned to the position of general superintendent, after the lease to the Michigan Central. The division of which he will have control extends from East St. Louis to Frankfort, Ind., a distance of 243 miles.

OBITUARY.

BRIG.-GEN. ANDREW ATKINSON HUMPHREYS, who had been on the retired list of the United States Army since Jan. 30, 1869, died suddenly at his residence in Washington on Dec. 27. of angina pectoris in the seventy-fourth year of his age. He was born in Philadelphia Nov. 2, 1810, and was the son of Samuel Humphreys, Chief Constructor of the Navy. He was appointed a cadet in the Military Academy at West Point July 1, 1827, and was graduated with the rank of Second Lieutenant on July 1, 1831. He was assigned to the Second Artillery, but served until the following April on special duty as Assistant Professor of Engineering at the Academy. He saw his first active service in the war against the Cherokee Nation in Florida. He was engaged in this service in 1832-3. The next two years were spent by the young officer in garrison and topographical duty in Georgia, until the breaking out of the Seminole war in 1836, when he again took the field, and exhibited great bravery in the action of Oloklikaha, on March 31, and the battle near Micanopy on June 9. For his bravery in this war he was promoted to be First Lieutenant on Aug. 16, 1836, but the following month he resigned his commission and returned to private life.

Lieutenant Humphreys now entered the service of the United States as a civil engineer, to assist Major Bache on the plans for the Brandywine Shoal Light-house and the Crow Shoal Breakwater, Delaware Bay, and he was engaged in this work until July 7, 1838, when he was reappointed to the army with the rank of First Lieutenant, Corps of Topographical Engineers. In this capacity he did able engineering work for the Government, among the more prominent undertakings being the improvement of the harbor of Chicago, the survey of Whitehall Harbor, and the construction of the bridge at Washington. From 1844 to 1849 he was in charge of the Coast Survey office at Washington, and while there received his commission as Captain on May 31, 1848. The topographic and hydrographic survey of the delta of the Mississippi River was made under his directions in 1849-50, and he had general charge of this work until 1854. His active exertions in this labor prostrated him in 1851, and he was on sick leave until 1853, when he went to Europe and spent a year in examining means of protecting deltas from inundation. On his return he was placed in general charge, under the War Department, of the office duties at Washington connected with the explorations and surveys for railroads from the Mississippi River to the Pacific, and geographical explorations west of the Mississippi, a position which he ably filled until the breaking out of the civil war in 1861. In the meantime he had served as a member of the Light-house Board, of the board to revise the programme of instruction at the West Point Academy, and of the commission created by Congress in 1860 to examine into the organization, system of decipline, and course of instruction at the Military Academy.

Upon the breaking out of the Rebellion he became Major of the Corps of Topographical Eng'rs. August 6, 1861; from March 5, to Aug. 21, 1862 was Chief Engineer of the Army of the Potomac; was made Brigadier Gen. of Volunteers April 28, 1862; on Dec. 13, 1862 was brevetted Colonel in the Regular Army and May 3, 1863 was promoted to Lt. Col. Corps of Engineers. He was made Maj. Genl. of Volunteers for gallantry at Gettysburg. Nov. 25, 1864 Genl. Humphreys was given the command of the Second Army Corps, and held this position until the end of the war.

He was made brevet Brigadier-General, United States Army, on March 13, 1865, for gallant and meritorious services at Gettysburg, and brevet Major-General, United States Army, on the same day, for his services a Sailor's Creek. On June 27, 1865, he was placed in command of the Military District of Pennsylvania, in the Middle Department, a command which he held until Dec. 9, when he was assigned to his old engineering work, being placed in charge of the examination of the Mississippi levees, a work which occupied him until Aug. 8, 1866 when he was placed in command of the Corps of Engineers and in charge of the Engineering Bureau, in Washington and promoted to the full rank of Brigadier-General and Chief of Engineers. He was mustered out of the volunteer service Aug. 31, 1866.

Gen. Humphreys remained at the head o the Engineering Bureau of the army until June 30, 1879, when he was retired at his own request, Col. Horatio G. Wright succeeded him. During his services as commander of the Engineering Corps he also served on many important commissions, among which were the commission to examine into canal routes across the Isthmus of Panama, from 1872 to 1877, the Board on Washington and Georgetown Improvements, the Revising Boards for Bulkhead and Pier Line of Brooklyn, of Staten Island, and of the Hudson River; the Board for the Survey of Baltimore Harbor and Adjacent Waters, and the Washington Monument Commission. He was a gentleman of cultivated literary tastes, and the author of a book on the "Physics and Hydraulics of the Mississippi River," and of a volume in the series "Campaigns of the Civil War." He was honored with the degree of LL. D. from Harvard, in 1868. He was a member of the American Philosophical Society, of Philadelphia; the American Academy of Arts and Sciences, of Boston; of the National Academy of Science, of which he was one of the incorporators, and honorary member of the Imperial Royal Gelogical Institute, of Vienna, and of the Royal Institute of Science and Art of Lombardy, of Milan, Italy.

JOHN OSBORN, civil and hydraulic engineer, committed suicide at Wallingford, Conn., on Jan. 1. His mental condition had been a matter of concern to his friends for some time past. Mr. Osborn was about 60 years old, resided at Centreville, Mount Carmel, and leaves property worth at least $150,000. His business has been that of superintending the construction of water-works. The water-works of Cahoos and Millerton, N. Y., and Waterbury, New Britain, Granby and Simsbury, in Conn., were built under his supervision. The Fair Haven water-works, which were constructed when Benjamin Noyes and C. S. Maltby were in control, and which were afterward purchased by the New Haven Water Company, were built by him. The water rights of Lake Saltonstall—the Yale College rowing ground—were owned by him until bought, two or three years ago, by the New Haven Company. The last work he performed was the building of the Wallingford water-works. The work has given every satisfaction to the residents of the borough, but the details attendant upon pipe-laying and dam-building greatly worried Mr. Osborne, and his suicide is due, doubtless, to nervous prostration.

SELECTED MISCELLANY.

THE cellars under Philadelphia's new City Hall are the largest in America, their area being 4½ acres. The first cellar is thirteen feet deep, and the cellar under that is of like depth.

THE four highest points in the Empire State, aside from the mountains, are: Fabius, Onondago county, 2,020 feet above mean tide; East Hill, United States Coast Survey, 2,031; Babcock, Schoharie county, 2,117; and Summit, Schoharie county, 2,428.

IOWA'S new Capitol which was built of Missouri yellow and grey stone on a granite foundation, is 363 feet in length by 246 feet in width, and 92 feet in height to the top of the cornice; to the top of the ball over the main dome, 295 feet. The edifice cost $2,362,531.

THE rise and fall of the great lakes is puzzling the old settlers. At Grand Traverse Bay the water slowly rises for seven years, and then recedes for the same length of time. The Sault Ste. Marie *Democrat* says that the water in the "Soo" is lowering every day. At Traverse City the water is encroaching on the west side of the bay.

Iron (London) says that the undergound telegraph cables are inserted in cast iron pipes laid at a depth of more than 1½ meters, chambers for repairs being inserted every 500 meters. Every 100 meters the pipes are united by cast-iron couplings, permitting inspection and repairs. Joints between pipes are made with an india-rubber washer or lead collar.

A PARLIAMENTARY paper just issued shows that the expenses incurred by railroad, gas, and water companies in the United Kingdom in promoting and opposing bills before Parliament frum 1872 to 1882 inclusive, was $23,324,370. A large proportion of this is due to the cost of bringing up witnesses to Westminster and keeping them there.

AN architect, writing lately to the London *Building News*, lays emphasis on the overstocked state of the profession: "The few busy months were soon over, and I again left, and for three years was seeking employment, at the same time doing what I could for a living, perhaps under value. I had my bread to earn, as my parents thought that, when paying my premium and maintaining me through my five years' apprenticeship, they were going a good way toward setting me up in business; but to my cost, too late, I found they were mistaken, and that the market was already overstocked." There is a natural tendency on the part of Pecksniffs to disguise the adverse prospects of their profession in order to get the premiums of pupils. Another writer says that the colonies offer no better field. Here it is a very fluctuating vocation.

THE Copland system of asphaltic wood pavement, introduced in London, is claimed to meet some of the most important requirements for the purpose which have hitherto been unfulfilled, and, though more costly at first than some other methods of roadway construction, its durability and satisfactory wear, more than meet that point. The advantage of simplicity is at once presented, namely, a bed of concrete, with a layer of asphalt over it, upon which are laid transverses of red pine blocks, with intermediate spaces; these spaces are filled in partly with heated mastic asphalt, and then with coarse lime and gravel grout, flushed with hot air, to the surface of the roadway. Finally, about an inch of rough gravel is spread over the whole, and left to be worked in and compacted by the ordinary effect of traffic.

SOME investigations by M. Thanneur show that South America is rich in woods for engineering purposes. The yandubay is exceedingly hard and durable; the couroupay is also very hard and rich in tannin. The quebracho is, however, more interesting than any, and grows more abundantly in the forests of La Plata and Brazil. It resembles oak in the trunk and is used for railway sleepers, telegraph poles, piles, and so on. It is heavier than water, its specific gravity weighing between 1.203 and 1.333. The color, at first is reddish, like mahogany; but grows darker with time. Being rich in tannin, it is employed for tanning leather in Brazil, and has recently been introduced into France. A mixture of one-third of quebracho and two-thirds of ordinary tan gives good results.

THE pyramid of Cheops is dwarfed by that near Magdalena, Mexico. The Chihuahua *Enterprise* says that it has a base of 1,350 feet, and is 750 feet high. There is a winding roadway from the bottom leading up on an easy grade to the top, wide enough for carriages to pass over, said to be twenty-three miles in length. The outer walls of the roadway are laid in solid masonry, huge blocks of granite in rubble work, and the circles are as uniform and the grade as regular as they could be made at this date by our best engineers. The wall is only occasionally exposed, being covered over with debris and earth, and in many places the sahuaro and other indigenous plants and trees have grown up, giving the pyramid the appearance of a mountain.

American Society of Civil Engineers.

A meeting of the Society was held on Jan. 2, the following persons were elected members of the Society:

MEMBERS: Frederick Brooks, Civil Engineer, Boston, Mass. William Hammond Hall, State Engineer of California, Sacramento, Cal. Charles Warren Hunt, Civil Engineer, New York City. Stillman Williams Robinson, Professor of Mechanical Engineering, Ohio State University and State Inspector of Railroads and Bridges, Columbus, Ohio.

JUNIOR: Edward E. Magovern, Assistant Engineer New York Steam Co., Hoboken, N. J.

The death on Dec. 27, 1883 was announced of Gen. A. A. Humphreys U. S. A., Honorary Member of the Society. Arrangements for the annual meeting of the Society on January 16th and 17th were read.

Arthur V. Abbott, Jun., Am. Soc. C. E., read a paper on "Some Recent Improvements in Testing Machines," illustrated by the stereoptican. This paper was of exceeding interest but too lengthy and intricate in the mechanical contrivances described to be given, even in part, in a hasty review. The machines are manufactured by the Fairbanks Scale Co., and contain many novel features, prominent among them being the ability to test the machine itself by piling on the platform standard weights, the automatic recording appliances operated by electric currents, and the automatic shifting of the greater and lesser weights on scale-bar, actuated by the same electric motive power—to compensate for variations in the stresses in the test bar.

Mr. Abbott also exhibited a very simple and compact cement testing machine, built by the Fairbanks, in which the breaking weight was represented by a variable quantity of shot emptied into a brass pail, and the shot itself weighed on the same machine. He showed too, a delicate but most perfect mechanical contrivance for measuring the stress in the working members of an erected truss, the invention of Col. Wm. H. Paine, the President of the Society. This little testing machine was used at the late opening of the Niagara Cantilever bridge, and essentially consists of two small bars sliding past each other and carrying a vernier, a delicate lever arm with a knife edge, etc., is attached at one end in such manner that any stretching of the member under test, to which the sliding bars are firmly attached by clips, moves a sliding vernier placed at right angles to the bars, and indicates the amount of stress. Strain sheets from the large testing machine and test pieces of steel, iron and wood broken and crushed upon these machines were exhibited.

"THE Commissioners appointed under the law passed by the N. Y. Legislature, for the purpose of selecting and locating such lands in the village of Niagara Falls as may be necessary to be reserved for the purpose of preserving the scenery of the Falls of Niagara, have determined upon the lands which, in their opinion, should be reserved, and a map has been duly certified by them and filed as directed by the statute. Proceedings will be taken as soon as practicable for the appraisal of the land so selected with a view of determining the cost attending the proposed reservation. The project of releasing this far-famed natural wonder from the obstacles to its enjoyment which now surrounds it, and securing its scenery from destruction, appeals strongly to our State pride. It, has, besides, certain features of practical benefit to our people which renders its success desireable if the expense attending it is not too great. The State is in no way committed to the consummation of the proposed reservation, and the whole matter will be submitted to the Legislature for its determination upon the report of the Commissioners, when the same shall be presented."

CORRESPONDENCE.

MEMPHIS SEWERAGE.

Special Correspondence Engineering News.

KANSAS CITY, MO., Dec. 29, 1883.

EDITOR ENGINEERING NEWS:—Being engaged in constructing sewerage in Leavenworth, Kansas, I have recently spent some days in examining the sewerage of Memphis, with which I have also been somewhat familiar from soon after its first construction.

I have not found any changes in the plans made by Col. Waring, unless the addition of some man-holes which were omitted as a temporary economy, and some other similar additions, may be considered in that light. On the other hand, much of the work which has been cited by engineers as exceptionally well done, and therefore successful, where ordinary work would be liable to failure, was found to be badly done by reason of the hurried work necessary at the time, and as a whole it is not better than ordinary practice. In addition to this, the water furnished by the water company is at times so muddy as to require large openings to prevent the small pipes from clogging; resulting in an amount of water entering the sewers which they were never expected to carry. Notwithstanding this, one 12-inch sewer laid where Col. Waring wanted a 15-inch sewer, is now carrying the outflow of some thirteen miles of sewers successfully although having a slight grade. In another case an 8-inch sewer was found with a rising grade of over its diameter in a short distance, and this has never given any trouble.

So far as I was able to learn, the original twenty miles of sewerage has been more than doubled with very little addition to the original plant, and no changes in any way affecting the theory on which the system was constructed. In conversation with prominent citizens I found but one opinion, and that was that the system was a complete success. G. W. PEARSONS.

THE FIRST CANTILEVER BRIDGE.

Special Correspondence Engineering News.

ENG. DEPT. W. P. RY. COLO. DIV.
DENVER, COLO., DEC., 27, 1883.

EDITOR ENGINEERING NEWS:—I was much surprised to see in your issue of Dec. 15th under the head of "Other Cantilever Bridges," the following statement. "The Central Bridge Co. of Buffalo, have the honor of raising the first cantilever in America." Especially surprised when every week you published in your paper a cut of a cantilever bridge *erected years ago*.

The cantilever bridge over the Kentucky River, on the Cincinnati Southern Railway has been in constant use since Feb. 20, 1877.

The contract for this bridge was let to the Baltimore Bridge Co. July 9, 1875. The erection of this superstructure was commenced Oct. 12, 1876. It was completed Feb. 20, 1877, and tested April 20, 1877.

This bridge was designed and erected by Mr. C. Shaler Smith, the Engineer of the Bridge Company.

The dimensions of the Kentucky River Bridge are as follows: Total length 1,125 ft.; height above low water 274.89 ft.; distance from abutments to hinge of cantilevers 300 ft.; distance from hinge of cantilevers to iron towers 75 ft.; distance between iron towers 375 ft.

This bridge was erected without false works being built out from each abutment to the center of the river. Hence the Niagara bridge is neither the first nor the longest cantilever bridge in America.

As to your further statement in the same article, that "the first design for a large span (cantilever) ever accepted was made by Charles Macdonald, etc." I can only say that in the fall of 1873, in company with several engineers on their way to New York, while discussing the proposed Kentucky River bridge, Mr. C. Shaler Smith sketched on a piece of paper the plan of the bridge as he would build and erect it if he were given the contract. The contract was let to him (Baltimore Bridge Co.) July 9, 1875, and the bridge was erected.

These facts were in my possession at the time the bridge was tested, and while returning that day to Cincinnati on the special train from the test, I related them to Mr. Smith and he told me they were correct in every point.

Therefore I believe that to Mr. C. Shaler Smith and the Baltimore Bridge Co. belong the honor of *designing and erecting the first* cantilever bridge in America. Respectfully

ROBT. B. STANTON,
Div. Eng.

TRADE AND THE WINTER.

From the greater part of the manufacturing districts of the kingdom we hear of men discharged, work slack, orders few, strikes imminent, and all the signs that point to a winter of distress, if not disaster, unless a system of "give and take" all round be not amicably arranged. On the Clyde the tension is great. Men are going out on strike for reasons that have no weight at a time when masters are giving notice of a reduction of 10 per cent., and are contemplating or actually discharging large numbers of their hands. One of the newest of the Christmas annuals has a tale with a moral, the title of which is "It Only Wants Turning Round." The issue of the *Christian Million* containing this tale has been sent to us, and we think the idea and the moral of the tale are worthy the consideration of every working man. Look at the question from all sides before coming to a final decision. Ten per cent. reduction at a time when nature imposes an increased expenditure is by no means a pleasant prospect; but it may be urged that ninety per cent. is left, and that this is better than nothing. The idea has been started that the low price of coal for example, and the consequent lowness of colliers' wages, is the result of an accumulation of capital. This is indeed a bold way of putting what is regarded as a fundamental law of economics, the discussion of which we need not dwell upon at any great length. There is in business as in natural operations a constant change. Capital is released in one quarter by these changes, and required in another. A sudden, and it may be ephemeral demand for certain articles invites capital to the production of those articles over and above the requirements of normal wants. It is only natural, and it is essential that capital should be compelled to withdraw from such a position, and find another opening when the sudden demand ceases. The ability to produce ships is far greater than the prospective demand for ships, and hence partial idleness in the yards is the inevitable result. Neither strikes nor any other action can change the inevitable. In some manufactories the capitalist does attempt to help the workmen, when the depression is looked upon as temporary, by making for stock. Such actions must necessarily be temporary. Stock cannot be infinitely increased, and if the demand does not increase the capital retires. The crucial point which has over and over again been referred to in these columns—and so far as we know is utterly ignored by the never-soil-your-hands economist and philanthropist, and is never mentioned by politicians or wire-pullers of any kind, because to systematically counteract the evil effects arising by changes under consideration would give them less power—is the distribution of labor. The want and the wretchedness of labor is the lever applied for their own ends by politicians. We have pointed out the inevitable law that a certain floating capital is constantly changing the direction in which it is engaged. Now, as a rule, capital is not allowed to remain idle, and utilization of capital means use of labor. Change in the direction of capital as naturally means change in the direction of labor. Men of science swear by the laws of the "conservation of energy"—men of business might just as well swear by the laws of the "conservation of labor." This is a new term to introduce into economic science; but a little consideration will show its utility and applicability Capital is essentially the outcome of labor; increase the one and you correspondingly increase the other. Was it Palmerston who said dirt was matter in the wrong place?—whoever it was stated a truism—and it is no less a truism because an anonymous author says it, that want and misery simply imply "labor in the wrong place." Some of our great engineers and large contractors have perhaps unconsciously been among the benefactors of mankind, and have done more than any other class to distribute labor.—*Contract Journal.*

The number of permits for the erection of buildings in Philadelphia city during the year 1883 was 6,045. Of dwelling houses 3,728 were built, against 2,280 in the year 1882. The buildings erected in 1883 other than dwellings and attachments were as follows: Stables and coach houses, 195; factories, 83; shops and foundries, 60; stores and warehouses, 48; offices, 21; churches and chapels, 17; engine and boiler houses, 17; dye and dry houses, 14; ice houses, 7; green and hot houses, 7; slaughter houses, 6; school and college buildings, 5; breweries, hospitals and hotels, each 4; laboratories, police railroad stations each 3; halls and car houses, each 2; 1 press house, 1 market house and 1 theatre.

NEWS OF THE WEEK.

Bridges.

NEW LONDON, Jan. 2—President D. S. Babcock, of the Stonington and Providence Railroad, and Gov. Waller, attorney for that road, with a surveying party were in this city last Saturday looking over the probable approaches for the contemplated Thames River bridge between New London and Groton. The proposed bridge will cross the river at Winthrop's Neck, at the northern quarter of the city, and its eastern terminus will be just north of the village of Groton. It is to be a mile or two below the Thames Navy-yard, thus cutting off that station from Long Island Sound except by draw.

It is to be less than a quarter of a mile long, a massive structure, on iron piers, with a great draw-bridge in the centre. Its estimated cost is $700,000 a sum which the construction of the approaches and payment of land damages will swell to $1,500,000. Plans of the entire work have been prepared, but have not yet been opened to the public.

The erection of the bridge will also tend to hasten the Norwich and Worcester division of the New-England Railroad in carrying its Allyn's Point extension, which now reaches from Norwich to Allyn's Point seven miles along the east bank of the Thames, to the village of Groton. The Norwich and Worcester Company voted nearly a year ago to complete the extension, and the route was surveyed last summer; next Spring, probably, will see active work begun in its construction. After its completion the stations of the Norwich and New York Transportation Company will be changed from New London to Groton, and the Sound steamers of that line will stop at the latter place.

Water, Gas and Steam.

THE Connellsville, Pa., water works, is provided with a ten-ich main leading from reservoir, instead of a *two-inch* main, as stated in our notice of these works in the issue of December 15th.

THE Gas Trustees of Philadelphia desire to build an extension to the Twenty-fifth Ward works, and lay a large quantity of new mains, the present plant being insufficient to supply the gas needed. The proposed extension will cost $500,000. The question to be first considered, however, is the right of the Trust to expend that amount on its own responsibility.

THE Springfield, Mass. almshouse board having charge of the construction of the new pavilion which will be used for treating noxious cases which come within the jurisdiction of the city physician met Dec. 27, and opened three bids. They accepted that of Common Councilman Charles McKay, his bid reading $2,800. The contract will be awarded in a few days in accordance with the specifications heretofore described.

D. A. KEIZER, C. E. of Manitoba, proposes to utilize the waters of the Qu'Appelle and Assiniboine rivers by canals, locks and dams, so as to create a "600,000 horse-power" for manufacturing purposes. Fourteen hundred miles of river are to be reduced to five hundred and fifty. Regina is to have a water supply of 100,000,000 gallons, etc. Another resident of the Province, however, doubts the feasibility of the plan proposed, and on the authority of Sandford Fleming, of Montreal, says Mr. Keizer has blundered in his levels.

THE Wellsville Water Works, N. Y., are completed. The source of supply is by gravity from Crowner's Brook; reservoir 5,000,000 gallons capacity, located in a ravine 4,700 ft. from the town, and 189 ft. above the main street, the reservoir is provided with a flood weir ten feet wide, in small dam at head of reservoir. The service main is 10 in. diameter, the distributing mains 8, 6, and 4 inches diameter. Adam Miller superintended the construction from plans of C. W. Knight, W. S. Kuhn contractor, who also built the works at Uniontown, Pa., and Connellsville, Pa. The franchise given Mr. Kuhn provides for thirty hydrants, at an annual rental of $1,200. The works have already 110 taps. The service pipe is lead and galvanized iron.

STEAM VS. WATER-POWER.—The minimum capacity and height of fall of some of the leading water-powers of the United States are as follows:

Holyoke, fifty feet, 17,000 horse-power.
Cohoes, No. 3, 105 ft., 14,000 horse-power.
Lewiston, fifty feet, 11,000 horse-power.
Lowell, thirty-five feet, 10,000 horse power.
Lawrence, twenty-eight feet, 10,000 horse-power.
Turners Falls, thirty-five feet, 10,000 horse-power.
Manchester, fifty-two feet, 10,000 horse-power.
Paterson, thirty-five feet, 1,100 horse-power.
Passaic, N. J., twenty-two feet, 900 horse-power.
Birmingham, twenty-two feet, 1,000 horse-power.

Fall River, with at least 500,000 more cotton spindles than any other town or city in the United States, is operated wholly by steam-power. Manufacturers have been heard to say that they would not move across the street for the sake of substituting water for steam, considering the irregularity of most water-powers. A more moderate statement is that of the manager of a prominent woolen mill on the sea-board, whom the writer asked if it would not be cheaper to run his mill by steam than by water. The answer was, "For a mill located as mine is, steam is the cheaper. I use half anthracite screenings and half culm coal from Nova Scotia. The average cost of both kinds of fuel landed on our wharf is $3.25 per ton, and at that figure steam is cheaper than water."—*Textile Gazette.*

Streets, Drainage, Sewerage, Etc.

A NEW METHOD OF OXIDIZING SEWAGE.—Professor J. Koinig proposes to purify town sewage and the waste water of slaughter-houses, dye-works, breweries, etc, by allowing them to trickle over a net work of wire, thus exposing a large surface to the oxidizing action of the atmosphere. He recommends that the coarser impurities should first be removed by means of settling-tanks.

BOSTON'S IMPROVED SEWERAGE.—The Committee on Improved Sewerage, in turning over to the city of Boston the new system on January 1st, were as informal as was General Sherman in transferring to his successor, General Sheridan, the management of the War Department a few weeks ago. There was, in fact, no ceremony whatever in the practical demonstration of what for several years past has been an experiment, and very few citizens have any idea of the magnitude of the enterprise which has so often been described. The committee, accompanied by a few invited guests, including Gen. Martin, the Mayor elect, and Mr. Leavitt, the builder of the engines designed for pumping the sewage, left the City Hall soon after ten o'clock in the forenoon and started for East Chester Park, where an inspection was made of the chamber leading to the main sewer running through that street. Here it was found that the sewage of West Roxbury, Boston Highlands, Beacon Hill, the Back Bay and a portion of the South End was passing through the sewer at the rate of three and a half feet per second, a much greater velocity than was anticipated. The trip was then continued to the pumping station at the Calf Pasture, where the honor of setting in motion the enormous engines devolved upon Alderman Slade, who has been Chairman of the committee since the scheme was first started, nearly seven years ago. The tank section, where the sewage enters the tunnel on its way to Moon Island, was then visited and everything found to be working in a most satisfactory manner. A tugboat was taken to Moon Island, where the visitors had an opportunity of seeing the sewage of Boston discharged into deep water at the end of the island. The time selected was a little after one o'clock in the afternoon, when the tide had begun to ebb, and the necessary machinery having been set in operation by Alderman Slade, the party awaited the result with a good deal of interest. Making their way to the end of the pier of Moon Island, which marks the extreme limit of the outfall section, the visitors found the sewage flowing out into the harbor at a rapid rate, and making as distinct a line toward the eastward, or in a direct course towards Massachusetts Bay, as would a Cunard steamer in shaping her course for Liverpool. It is calculated that with the amount of sewage now daily accumulating it will take an hour to empty the reservoirs at ebb tide, and some idea of the strength of the current may be obtained when it said that it would be almost impossible to propel a rowboat across the path of the sewage while it is in motion from the reservoir. The practical working of the entire system was somewhat of a surprise to the engineers having the work in charge, for they were prepared for some friction in the new machinery, which did not occur at any point in the line between Old Harbor Point and the outfall section at Moon Island. When entering the tugboat after witnessing the emptying of the sewage at Moon Island, Gen. Martin congratulated Alderman Slade upon the success of the enterprise, but with this exception no mention was made of the great scheme which had so successfully been carried to completion.—*Boston Herald.*

Railroads.

THE contract for the construction of the Ottawa, Morrisburgh and New York Railway was signed on Dec. 22, by Mr. Wright, of New York.

FROM an official statement of the Kansas State Board of Railroad Commissioners, Kansas has paid on an average, in cash and bonds, $2,200 for every mile of railroad in the State.

THE New York, West Shore and Buffalo Railroad was opened January 1, for through passenger and freight traffic; from New York to Buffalo. The road is 425 miles long, and excepting about fifty miles, is double track, laid with 67 pound steel rails.

THE New York and New England Railroad Company went into the hands of a receiver on Jan. 1. The company represents $36,000,000 capital, with $20,000,000 capital stock, $10,000,000 first mortgage bonds. The January interest of $330,000 and the floating debt caused the collapse, the efforts to meet these sums being unsuccessful.

The Commissioners who were elected by the City Council of Providence, R. I., nearly two years ago to devise plans for a new union depot and a better system of railway terminal facilities have made their second report. According to the Commissioners' estimate, the contemplated improvements will cost the city $694,632.83, and the expense to the railroads will be between $1,000,000 and $2,000,000.

WASHINGTON, D. C., Dec. 31.—The Committee on Public Lands expect to report a number of separate bills when Congress reconvenes declaring forfeited the lands granted certain railroad companies. The companies most interested are those in the Northwest and South. The amount of land involved, as reported by the Chairman of the committee, Mr. Cobb, is between 50,000,000 and 100,000,000 acres. The Texas Pacific land grant is expected to be reported forfeited. This grant alone involves 14,000,000 acres.

THE St. Louis and San Francisco Railway began using its own track between St. Louis and Pacific, thirty-four miles west, on January 1st, and hereafter will use its own terminal facilities at St. Louis. Heretofore the company has used the Missouri Pacific's tracks to Pacific. The new road was constructed and the ground for yards and a freight-house acquired at a cost of about $3,000,000.

THE Burlington, Cedar Rapids & Northern R. R. are preparing to build the 75 miles between Clinton and Elmira as soon as the weather will permit; and will relay the 24 miles west from Clinton, with steel rails. The bridges are being built on the line from Dowe, Wright Co. to Forest City, Hancock Co., (45 miles) and will open the road as soon as the frost will permit.

A CONTRACT was recorded in the Register's office between the Haskell & Barker Car Company and the New York, West Shore & Buffalo Railway Company, by which the former agrees to furnish the latter with 1,000 standard box cars of the aggregate value of $494,000. The cars are to be placed upon the tracks of the Michigan Central, Wabash, or Louisville, New Albany & Chicago Railways at Michigan City, Ind., within five months. Upon the delivery of the cars 10 per cent. of their value is to be paid. When the 20 quarterly payments have been made—the last of which will fall due in 1889—with interest, the purchase price will amount to $514,659.

THE House Committee on Railroads and Canals is abundantly supplied with members who have axes to grind. Chairman Davidson, of Florida, wants a ship canal across his own State. Hoblitzell, of Maryland, thinks the government should first of all make a similar way through his principality. Hatch, of Michigan, is suspected of a leaning toward the insane scheme for a ditch between Lake Michigan and Lake Erie, while Henderson, of Illinois, and Murphy, of Iowa, specially represent the Hennepin grabbing idea in their respective States.

HARRISBURG, Dec. 30.—A rumor has prevailed here for the past few days that the Harrisburg and Potomac Railroad, which runs up the Cumberland Valley parallel with the Cumberland Valley Railroad, has been purchased by Mr. Vanderbilt to be used as a portion of his proposed road. A special to the *Patriot* from Newville, Pa., says D. V. Ahl, the projector and now a director of the road in question, denies that any sale had taken place, but admits that the two roads are on friendly terms and that they will be connected whenever benefit will result. He also states that the Harrisburg and Western will have a direct outlet to Baltimore by the connection of the Harrisburg and Potomac with the Hanover and Baltimore.

It is rumored that the Connotton narrow guage, which runs from Cleveland down into the Coshocton Valley, may pass into the control of the Pan Handle Road, which would not only give the latter a road into Cleveland, but would open a new and convenient route from Cleveland to Cincinnati. Of course, in that case the guage would be changed to standard.

TORONTO, Dec. 25.—It is said that the Northern Railway running between Toronto and Gravenhurst will build a link connecting the Canadian Pacific with the Ontario System of Railways, and the Dominion Government will bonus the road to the extent of $12,000 a mile or $2,800,000 for the whole road, extending from Gravenhurst to Callender, the Southern terminus of Eastern or Lake Superior branch of the Canadian Pacific Railway.

THE Harlem River Railroad Company has filed its plans with the Secretary of State at Albany and the Register of this City. It has a capital of $2,000,000, and proposes to build a line of road extending from Woodlawn, the junction of the New York, New Haven and Hartford and the Harlem Railroads, to a point on the Harlem River at the northern end of High Bridge, connecting with the New York Central, the New York City and Northern, and the elevated roads at the Third and Eighth avenue bridges. The company has acquired ample dock and tunnel facilities where it can easily handle heavy freights. The officers are John H. Cheever, President; William Ryder, Vice-President; C. A. Cheever, Secretary, and G. E. Harding, Chief Engineer.

SPRINGFIELD, ILL., Dec. 31.—Articles of incorporation were filed to-day with the Secretary of State of the Inter-State Railway & Transfer Company, to build a line of railway from some point in Sec. 5, township 37 north, range 15 east, in Hyde Park, Cook County, Ill.., running thence to some point or points in Secs. 8 and 12, township 37 north, range 15 east, in Hyde Park, and with the right to extend its line to and form connection with other lines now built or which may hereafter be built in Illinois and Indiana. The principal offices are to be in the city of Chicago, and the capital stock $200,000 The time of the commencement of incorporation to be from the 27th of December, 1883. The incorporators and the first Board of Directors are E. B. Guthrie, George M. Black, J. B. Fraley, James Wilson, and V. D. Becker.

ST. PAUL and Minneapolis are fast becoming the centres of one of the greatest railway systems in the Northwest, a position which may be second only to Chicago itself. The *Pioneer Press* gives some interesting statistics in this connection which we reproduce:

NAME.	TRACK LAID.	WHAT COST.
Northern Pacific	753	$15,100,000
Milwaukee & St. Paul.	175	2,685,000
Manitoba	86	3,686,500
Northwestern	141	2,500,000
Omaha	145	1,400,000
S. Paul & Duluth	16	240,000
Minneapolis&St.Louis	3	170,000
Total	1,319	$25,781,500
New mileage for 1883		1,319
New mileage for 1882		2,400
New mileage for 1881		2,081
New mileage for 1880		1,478

BETWEEN $400,000 and $500,000 of the capital stock of the Hartford and Harlem Railroad Company was represented at the annual meeting of the stockholders on Dec. 29th ult. The following Directors were chosen: Albert M. Billings, of Chicago; Lewis M. Brown and Charles G. Eranckiyn, of New York; F. W. Bruggerhoff, of Darien; William H. Day, of Bridgeport; F. L. Higginson and Charles P. Whittier of Boston, and Henry G. Lewis, Henry Killam, and Samuel G. Thorne, of New Haven. Mr. Francklyn was chosen President, Lewis M. Brown, Vice-President, W. F. Van Pelt of New York, Treasurer, and Mr. Thorne Secretary. Prof. Simeon E. Baldwin, attorney for the Company, says it is the intention to build the road between the New York line and Greenwich and New Britain as soon as the location and lay-out are approved by the Railroad Commissioners. The company has nearly a year in which to undertake actual operations, in case the location now under consideration by the Commissioners is approved.

The Olmstead Road people, whose location, like that of the Hartford and Harlem, runs parallel to the tracks of the New York, New Haven and Hartford Road, are limited to some time in March, 1884, for the expenditure of the $500,000 necessary to secure the continuance of their corporate existence. Their lay-out has been approved. The backers of each road profess to believe that the rival line will never be built, while both speak with undisguised scorn of the Boston Inland, a project embracing the construction of an air line railway between New York and Boston.

HUNTINGDON, Dec. 31.—The Seaboard, Pennsylvania & Western Railroad, extending from Pittsburg to Ashland, Schuylkill county, at which points it connects with other roads belonging to the same system, has had a mortgage for $11,5000 in favor of the Farmers' Loan and Trust Company, of New York, in trust for bondholders, recorded in this county. The bonds are for a thousand dollars each, payable in gold after 30 years and bear interest at the rate of six per cent., payable semi-annually in gold. A route was recently surveyed for this road through this and adjoining counties under the name of the Delaware Water Gap and Southwestern.

THE directors of the Postal Telegraph and Cable Co., on December 28th, elected John W. Mackey, president; George S. Coe, Vice-President; Henry Cummins, Second Vice-President and General Manager; H. L. Horton, Treasurer; George R. Williamson, Secretary and Wm. H. Fairbank, Supt. of Construction. This completes the reorganization of the Postal Telegraph Company, which is now operating its line to Chicago, and has completed its pole line to Washington via Philadelphia and Baltimore; also from Chicago to St. Louis and from Buffalo through the oil regions to Pittsburg and from Fostorio to Toledo. The wires are being rapidly strung on these new lines, and they are to be opened for public business about the middle of February next.

ST. LOUIS, Mo., Dec. 28.—The Hon. Alex. G. Cochran, the legal adviser of Capt. J. B. Eads, has just returned from England, where he has been consulting with the latter concerning the proposed ship-railway across the Isthmus of Tehauntepec. In an interview to-day, he said: "The prospects are decidedly encouraging. When I left the other side Capt. Eads was busily engaged with a corps of draughtsmen and engineers in preparing a more complete set of models and plans than has yet been made to illustrate his project. He has succeeded in interesting not only the most prominent engineers, but also the large majority of shipbuilders and shipping merchants in his latest enterprise. They consider the scheme not only practicable, but one that will be of incalculable benefit to both English and American commerce. The project affords an additional interest to the English in the light of facts developed in the late De Lesseps controversy concerning the exclusive privileges of the Suez Canal. It is almost an assured fact that in the course of a few months some negotiations will be entered into to give the enterprise a definite shape and a successful start."

"Have any further steps been taken in this country to forward the project?"

"No, nothing in particular since the committees of both Houses of Congress reported favorably upon the scheme but failed to take any further action in the matter. Capt. Eads concluded he could do more in England than he could here, and from present prospects there is every reason to believe that his surmises will prove correct."

THE following statement of the operations of the Lake Shore and Michigan Southern Railroad Company, presented at the Directors' meeting in New York, December 26th, 1883, is partly estimated: Gross earnings, 1883, $18,550,000; do., 1882, $18,225,639; operating expenses, 1883, $10,975,000, do., 1882, $11,057,807; per centage of earnings, 1883, 59.17; do., 1882, 60.70. Net earnings, 1883, $7,575,000; do., 1882, $7,167,832. Interest, rentals and dividends on guaranteed stock, $3,550,000; do. 1882, $3,027,000. Balance 1883, $4,025,000; do. 1882, $4,140,832. Dividends eight per cent., 1883, $3,957,320; do. 1882, $3,957,320; surplus, 1883, $67,680; do. 1882, $183,512. Increase in gross earnings, 1883, $324,361; decrease in operating expenses, $82,807, and increase in net earnings, $407,168. Operating expenses include the cost of 10,000 tons steel rails and all other outlay for the maintenance of the property. The Michigan Central and Canada Southern annual statement, also submitted, made a good showing. December, partly estimated, gross earnings, $14,000,000; operating expenses and taxes, $9,700,000; percentage of earnings, 69.28; net earnings, $4,300,000; interest and rentals, $2,475,000; balance, $1,825,000; division as per traffic agreement via Canada Southern, one-third, $608,332; leaving Michigan Central, $1,216,667, appropriated as follows: Dividend, three per cent., August, 1883, $562,146; do. February, 1884, $562,146; total, $1,124,292; surplus, $92,375. Canada Southern report—Received under traffic agreement with Michigan Central, $608,333, which was appropriated as follows: Dividend, August, 1883, $300,000; do. February, 1884, $300,000; total, $600,000; surplus, $8,333. Dividends were declared December 26th on Lake Shore, Michigan Central and Canada Southern, payable February 1st. Lake Shore and Canada Southern pay two per cent, and Michigan Central three per cent.